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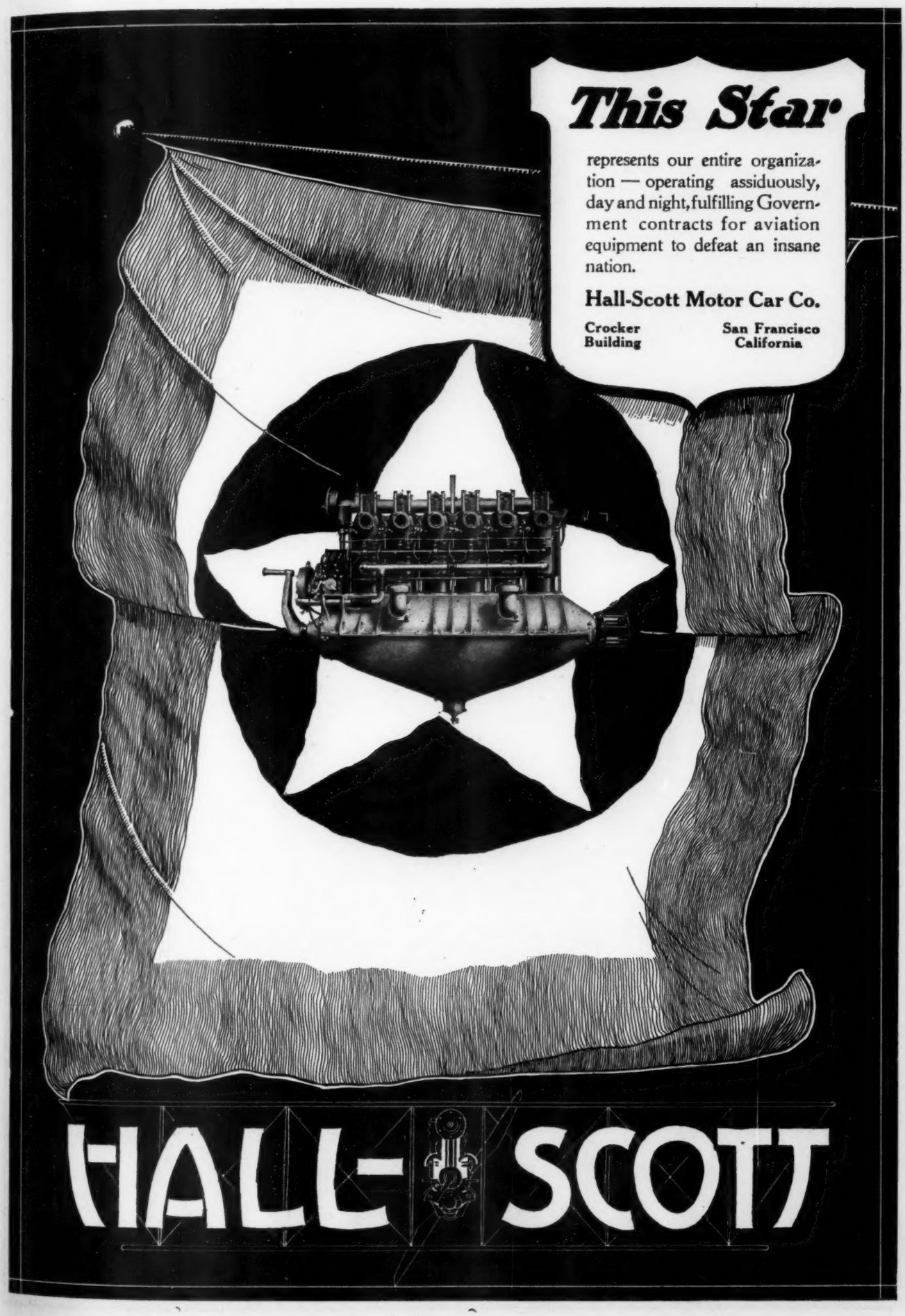
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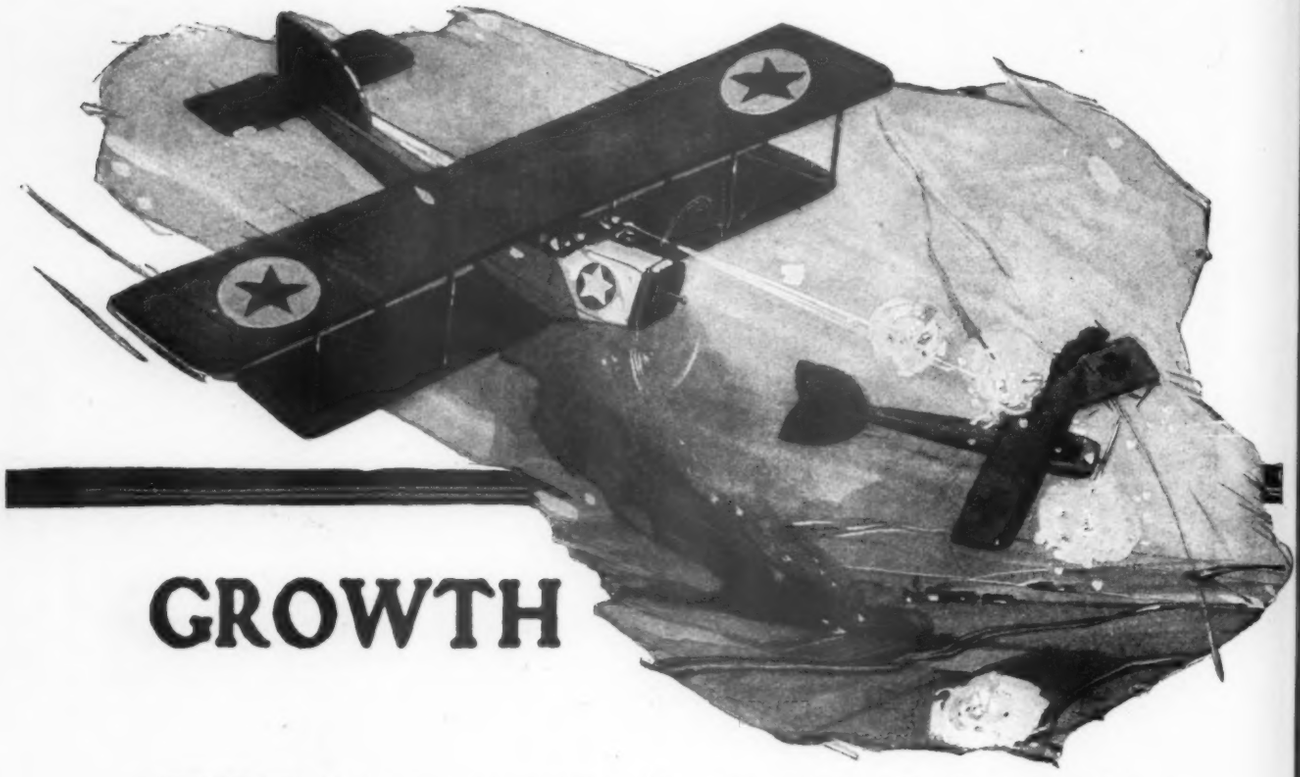

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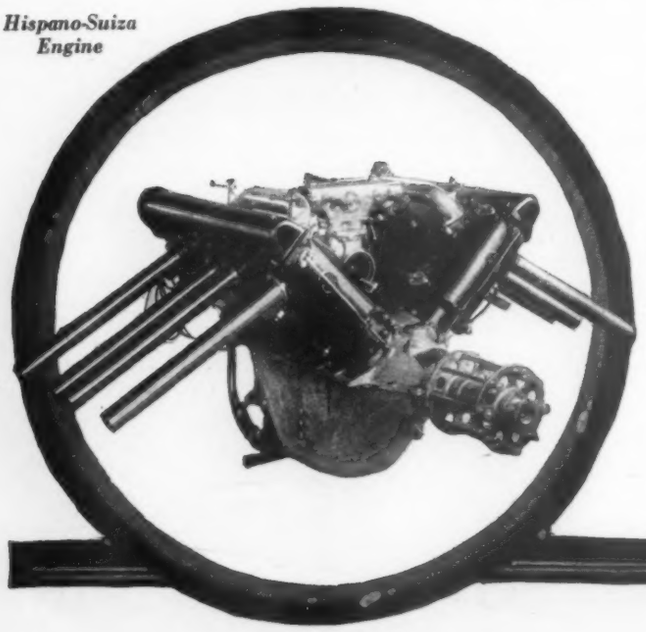

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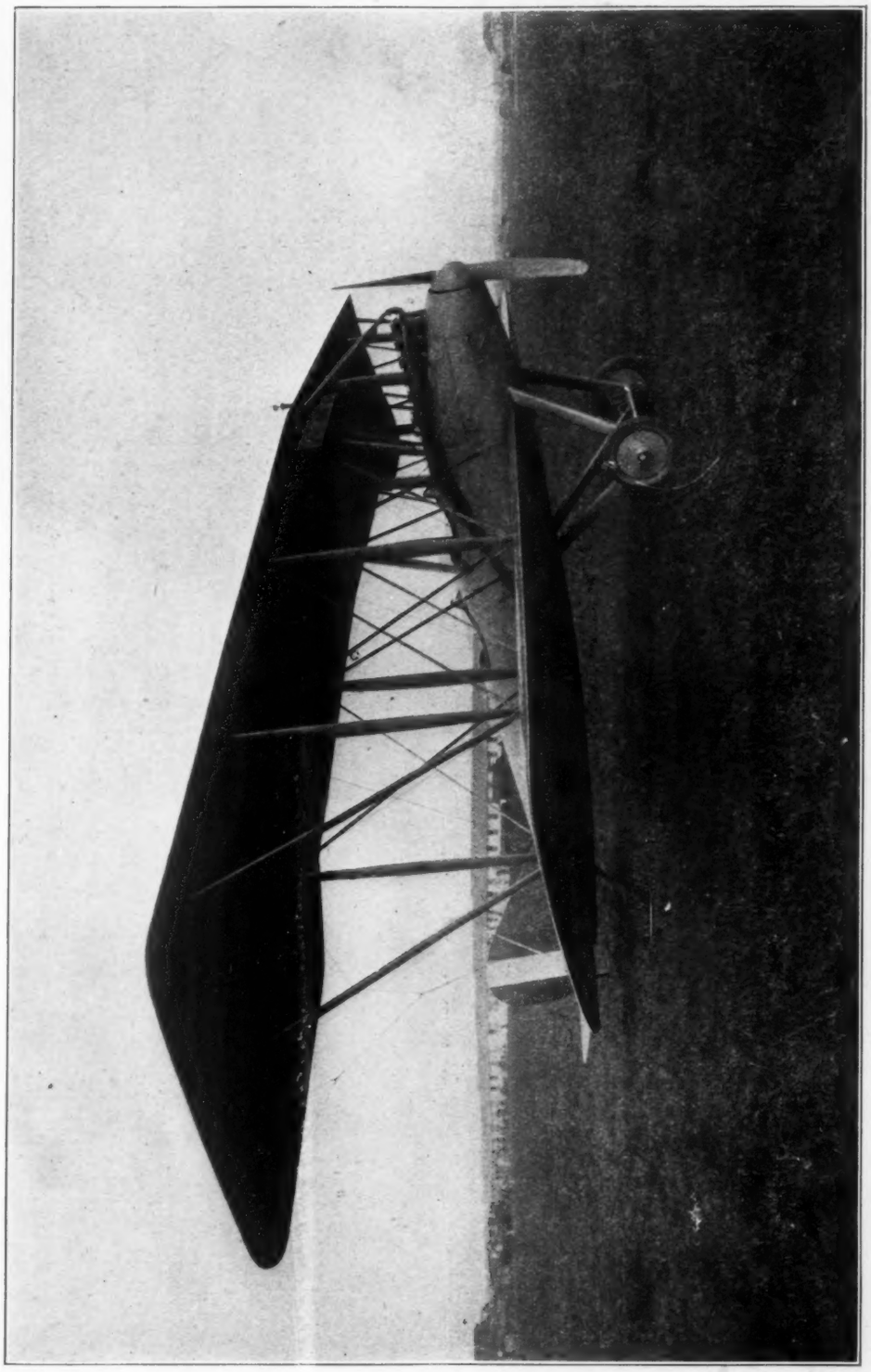

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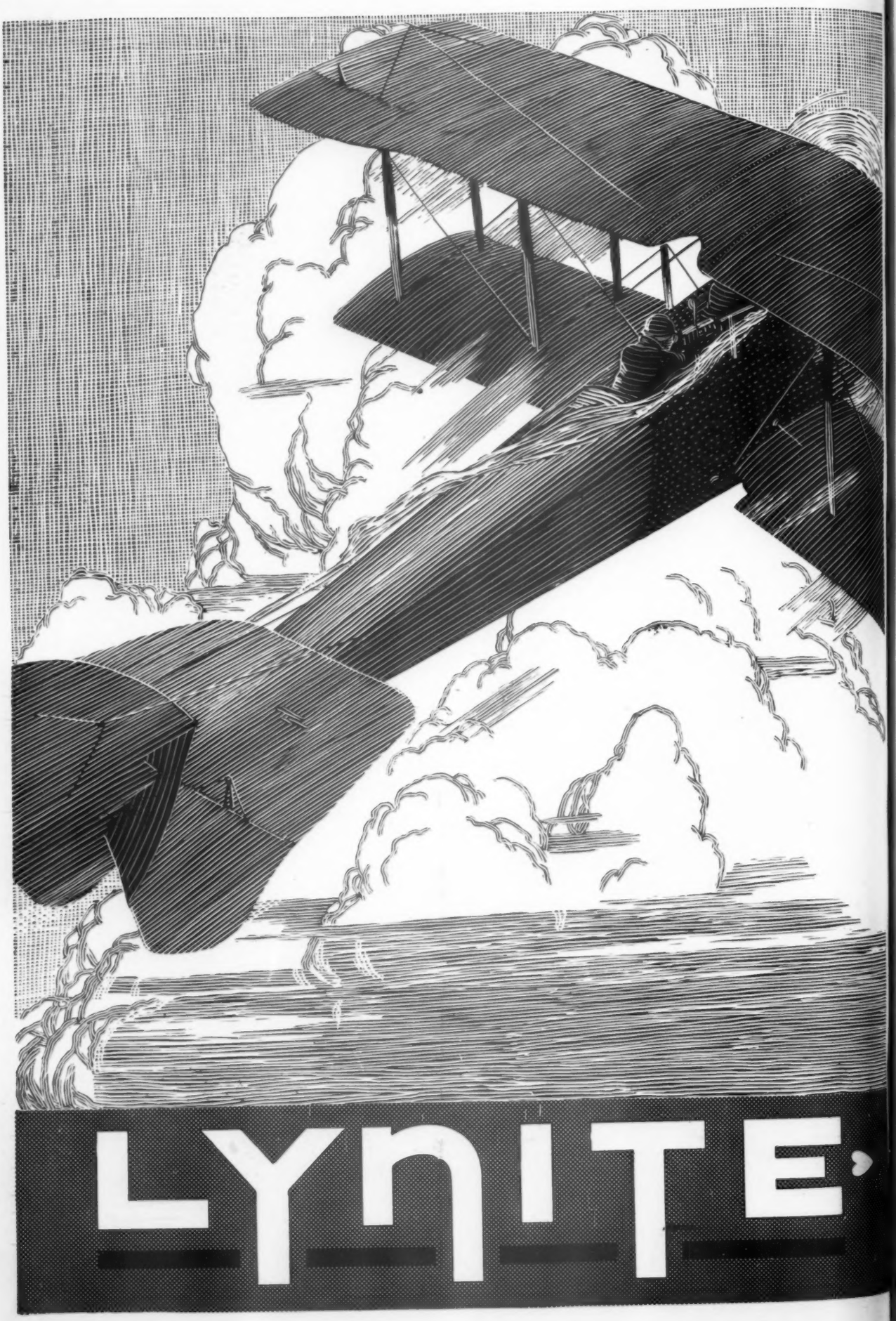
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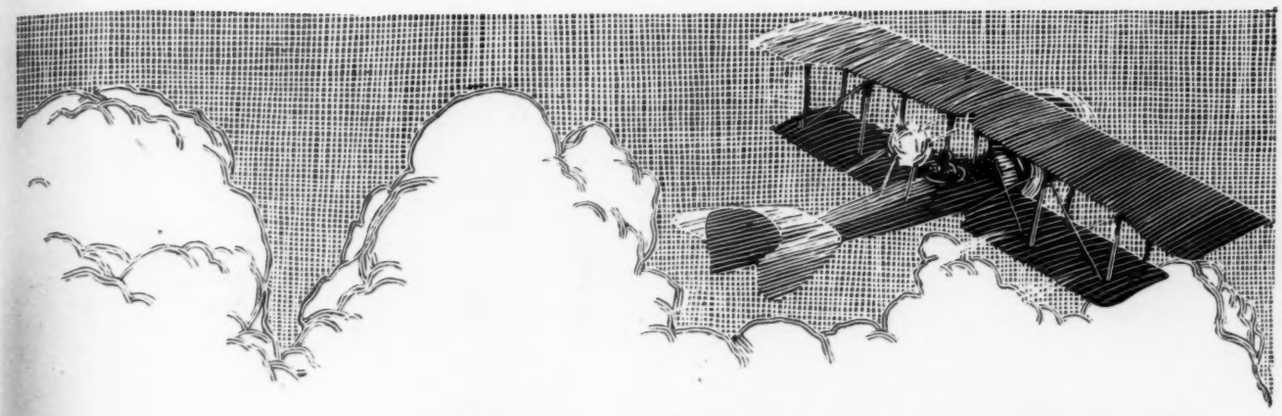

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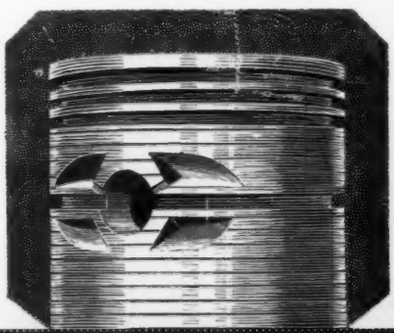

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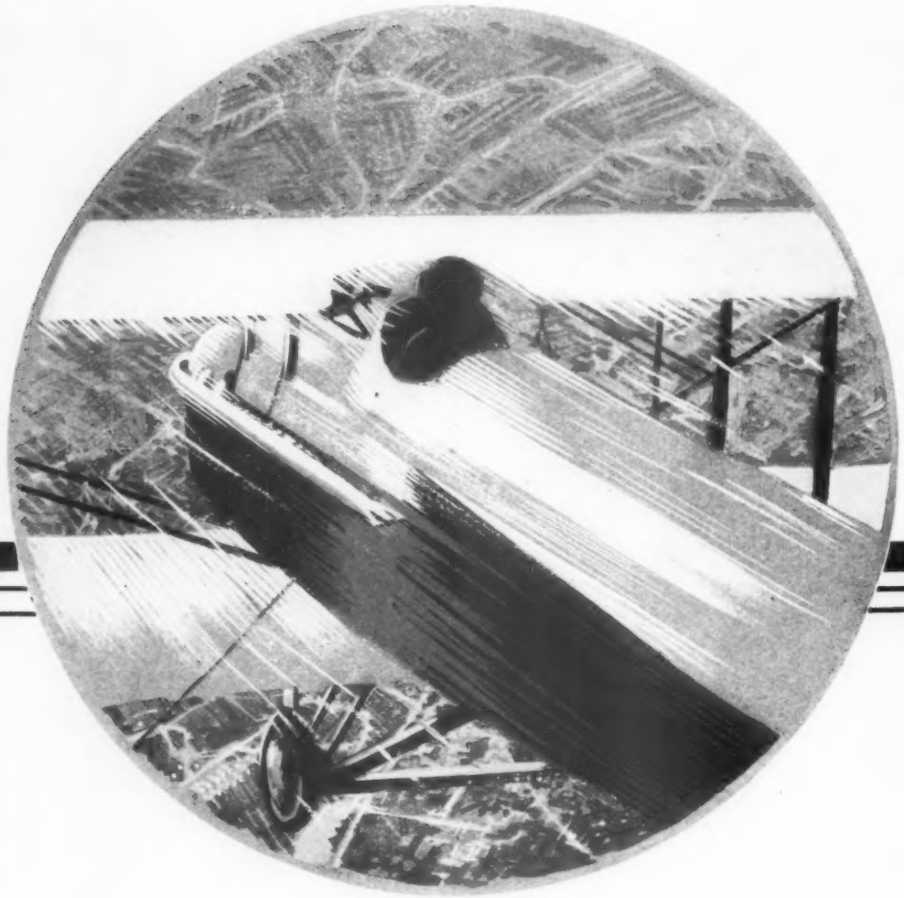

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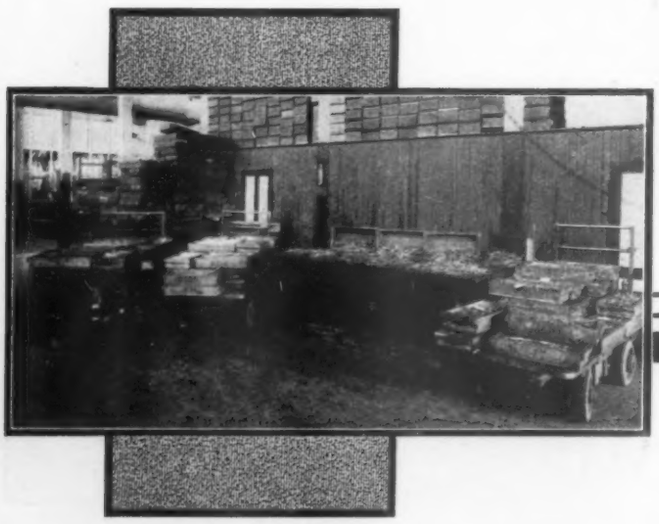

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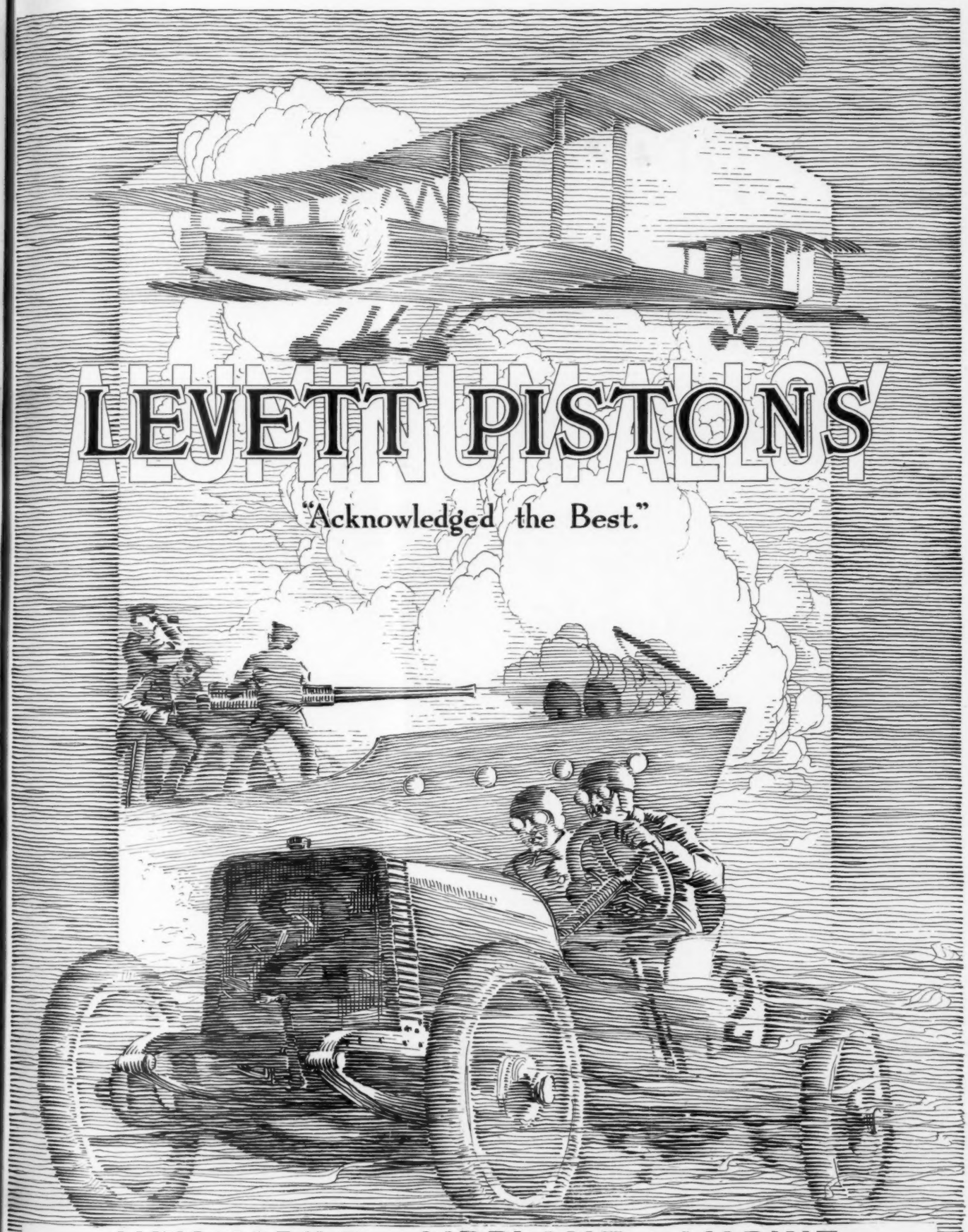

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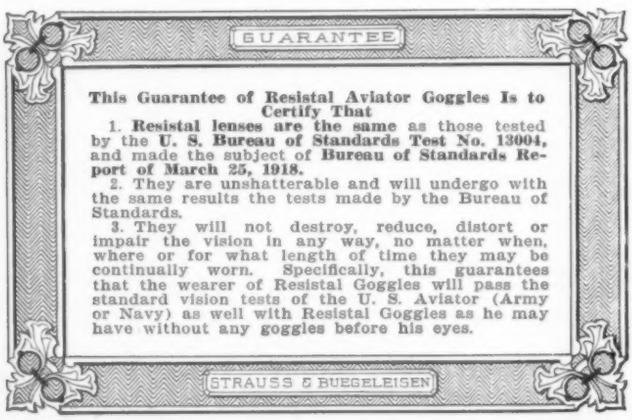

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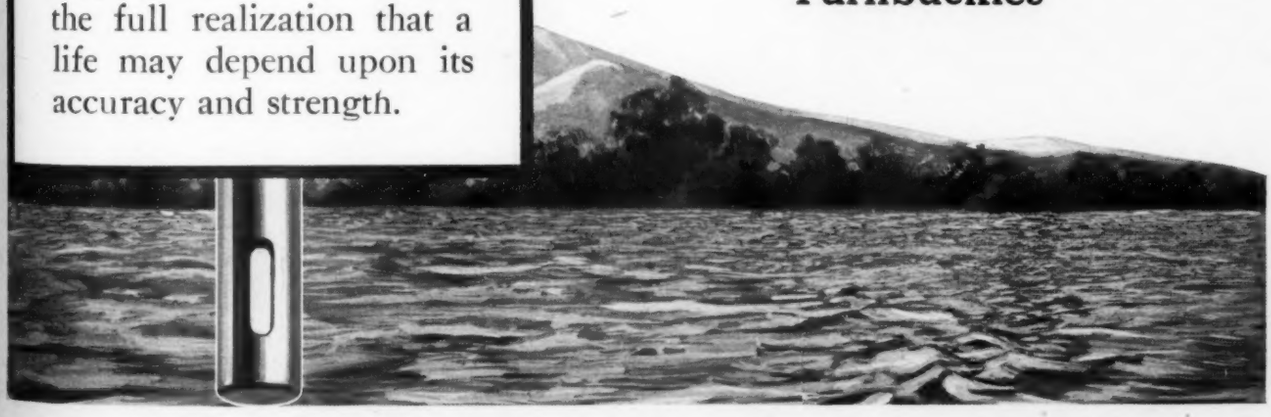

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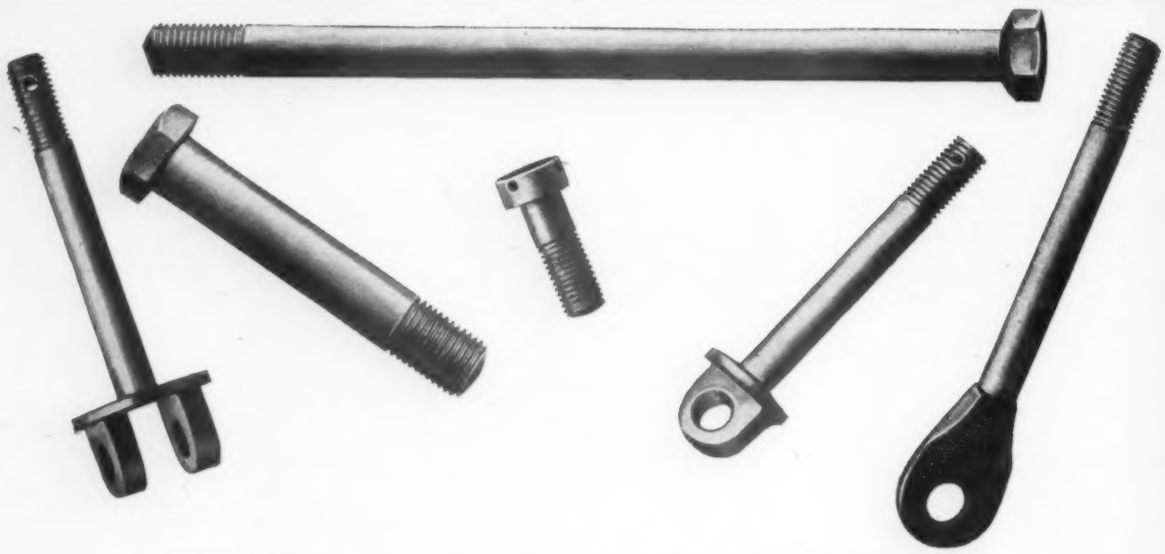

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VOL. IV. NO. 8

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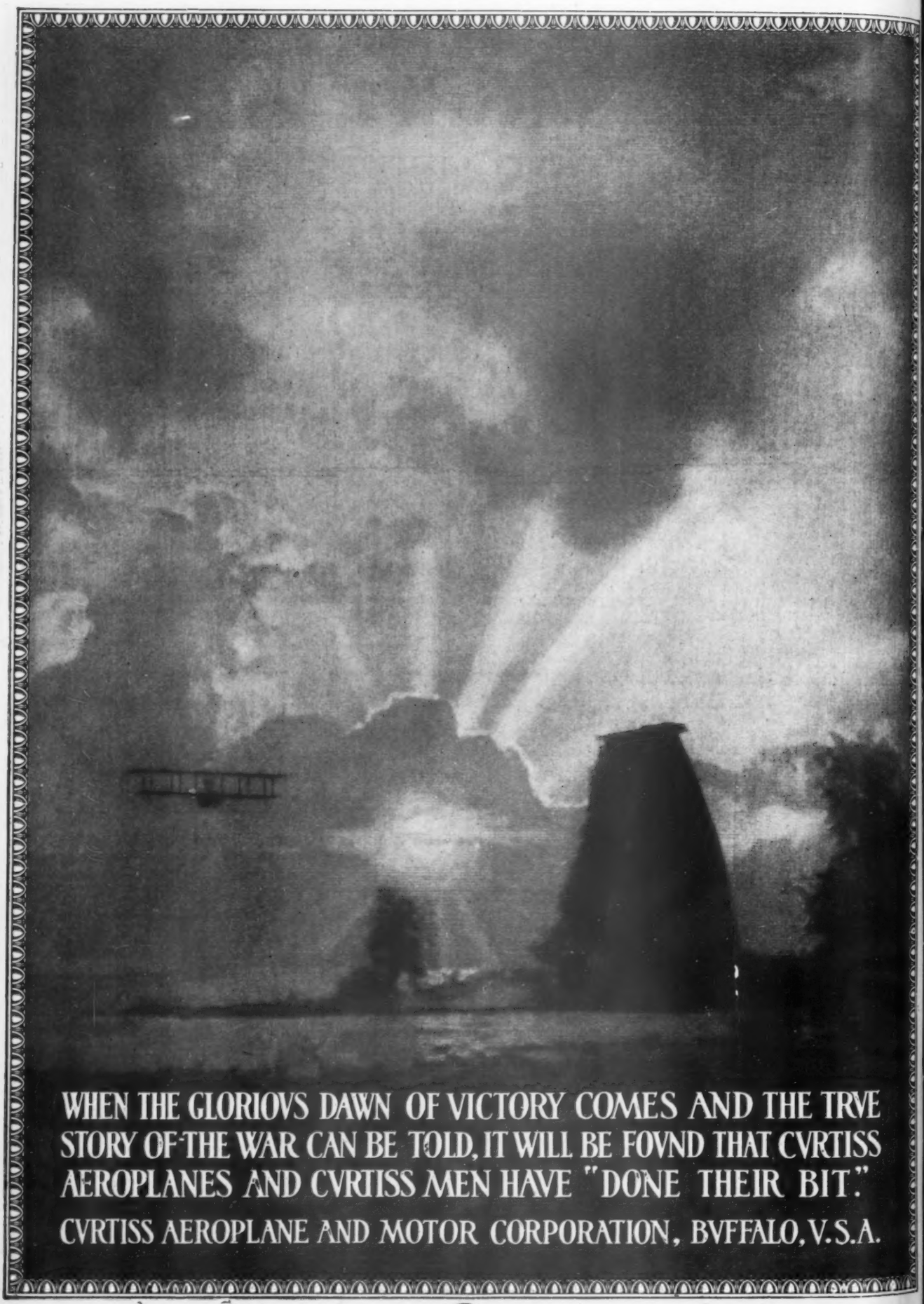
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Vol. IV | May 15, 1918 | No. 8

Theory of the Airscrew

By Professor Georges de Bothezat

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AVIATION AND AERONAUTICAL ENGINEERING *takes this opportunity of presenting to its readers a general outline of the results obtained by Professor Georges de Bothezat, late of the Polytechnic Institute of Petrograd, in his investigations of the mechanics of the airscrew. The results of these investigations, which are set forth in the form of a new theory of the airscrew, constitute a worthy scientific achievement which promises to have a marked influence upon this branch of aeronautical engineering both in the matter of primary conception and technique.*

Professor Georges de Bothezat, who is a Russian by birth, enjoys an international reputation among investigators of aerodynamics as the author of the first mathematical treatment of airplane stability, which he published in 1911, in Paris, under the title of "Etude de la Stabilité de l'Aéroplane" and which has since served as the fundamental treatise of this problem.

Having graduated from the University of Paris with the degree of Doctor of Sciences, M. de Bothezat was appointed by the Russian Minister of Instruction to fill the chair of applied mechanics and aerodynamics of the Polytechnic Institute at Petrograd. In this capacity he has made a number of valuable contributions to the science of hydrodynamics, aerodynamics, and aerial ballistics.

In the theoretical domain M. de Bothezat claims the authorship of several important works dealing with hydrodynamic resistance, the theory of the airscrew, and the determination of the definite oscillations of the airplane; in the practical field he created an original system of airscrew standardization and discovered the principle of the "invariable vertical" which he claims is of the greatest importance in insuring the correct aim of aircraft bombs.

M. de Bothezat is also the creator of two new types of airplanes, one of which he built in Russia during the war and fitted with his own type of airscrew. This machine has been tested in flight and has given results wholly in accord with the expectations of its builder.

The Bolshevist revolution having rendered impossible his continuing scientific work, M. de Bothezat decided to flee Russia; this he succeeded in doing at the peril of his life by travelling from Petrograd to Mourmansk in a cattle car, owing much of his escape to the "heroic devotion of the American Embassy officials and the officers of the American Military Mission to Russia" as he terms it. As M. de Bothezat has been fortunate enough to save from the Russian upheaval his most important scientific papers, one may entertain the hope that Russia's loss will eventually prove America's gain.

PROFESSOR GEORGES DE BOTHEZAT

The present theory gives a complete picture and an exact quantitative analysis of the whole phenomena of the working of the screw. This theory not only includes all the cases of its application, but also unites in a continuous whole the scale of states of work conceivable for a screw.

For studying the phenomenon of the working of the screw, I adopt as fundamental parameter a quantity which I call *relative pitch.* The relative pitch is the pitch of the trajectory of an element of the screw blade, measured by taking the pitch of the blade element as unity. I call the relation of the work of the thrust to the work of the torque applied to its axis the *specific function.* The curve of the specific function, as shown in the accompanying diagram, unfolds the completed cycle of the whole states of work possible for a screw.

For negative values great in absolute value of the relative pitch, the specific function is directed towards the origin of the co-ordinates by a sensibly rectilinear parabolic branch. Here we find ourselves in the region of the screw working as a brake, characterized by the fact that the current of water crossing the area swept by the blades of the screw has the same direction as the speed of the fluid current directed on the screw. The segment of this branch of the specific function which is directed towards the origin, as indicated by dots on the diagram, corresponds to a phenomenon discovered by me, in a purely analytical manner, for the first time in the present theory and named by me the *vortex ring working state.*

This phenomenon takes place in the following order: We imagine the screw working in the state of brake as above men-

tioned and consider the progressive lessening of its translational speed. In these conditions a moment arrives when a surface of discontinuity is formed in the wake of the screw across which the fluid will not flow.

Directly after its formation the surface of discontinuity divides into two surfaces and a vortex ring, the axis of which coincides with the axis of the screw, and appears in the space thus formed. The two surfaces of discontinuity which enclose the vortex ring move progressivelly apart, and a moment arrives when one of these surfaces crosses the space swept by the blades of the screw. This moment corresponds to the change of direction of the stream of fluid which flows across the plane of the screw and at once the screw inclines to make an infinite number of revolutions.

The curve of the specific function arrives at the origin by a cusp point. This is the whirling phenomenon,[1] immediately followed by a new brake state of work represented by a loop on the curve of the specific function. This latter state of brake work is terminated by the work of the screw at a fixed point. The screw fulfills then the functions of ventilator, helicoidal pump or helicopter. We immediately enter the region of positive values of the relative pitch. The screw becomes propulsive and the specific function represents the efficiency of the propeller.

After having passed a maximum, the specific function diminishes rapidly and passing through nil value brings us to a short interval of brakeage, which makes us pass asymptotically to the turbine work of the screw. In this latter interval the specific function represents the inverse of the efficiency of the turbo-motor.

After having passed a minimum which corresponds to the maximum of the turbo-motor efficiency, the specific function, by a parabolic branch, quasirectilinear, disappears into infinity, corresponding to the stoppage of the screw in a current which is directed on the screw. All this sequence of phenomena corresponds to the rotation of the screw in one sense. By the rotation of the screw in inverse sense, we obtain a series of phenomena of reverse rotation, which form, as it were, the reflected image of the forward movement.

The general equation of the specific function obtained leads directly to the determination of the most favorable conditions of screw-working in all the series of its applications. The maxima and minima of the specific function correspond exactly to the maximum of efficiency of the different states, separated from one another by the nil and infinite values of the specific function. We are thus naturally brought to the methods of calculation of the screw consequent on the conditions of its maximum efficiency.

The system of fundamental equations obtained by us thus shows all the properties of the screw in all the variety of its different working conditions. We thus obtain a complete solution of the whole series of those important problems which have been standing so long, owing to the requirements of practice in the applications of the screw, and which have, up to the present, remained without any satisfactory solution.

I have arrived at all these results, on the one hand, by the conceptional definition of the screw problem of which the normal working conditions are the expression, and, on the other hand, by the employment of a method of solving hydrodynamic problems, which I call the *empirico-theoretical method*. These two sides of the question are of such importance that I must stop to examine them generally.

When a new problem is raised, before proceeding to its soluton, two stages should be distinguished. The first is that where the thought seeks to formulate the statement of the question. It is only afterwards, when the problem has been formulated, that we can, properly speaking, approach a solution.

All the great scientific conquests of human thought have always begun by a partial conception of the problem to solve. The conceptional definition of a problem is distinguished by the fact that it is only an abstraction from the world of our sensations, only a mental approximation of the reality of the external world.

A simple example will suffice to give point to my idea. Let us take the problem of the motion of a rigid body. It is a well known fact that in nature no solids exist in the absolute meaning of mechanics. So, all the mechanics of the solid is only an approximation of reality; but the whole value of this approximation lies in the fact that numerous natural bodies approach in certain conditions so nearly to an absolute rigidity that the established laws of the mechanics of solids give a description of actual solids, which, in general, exceeds all the demands of applied science.

The problem once stated, an exact solution can be sought. It is only of the exactitude of the solution that there can be any question. All problems in themselves can only be an approximation of reality. That is why we should never persist too much on finding exact solution of problems which present too considerable difficulties. The whole value of the numerous methods of approximation lies in the fact that the results obtained are, so to say, of the same degree of exactitude as the conception of the problem. Important problems remain long without being solved, only because their very conception has not been sufficiently thorough. The screw is such an example. A more thorough conception, while making the solution easier, often brings us still nearer to reality.

The empirical-theoretical method to which I have had recourse for the solution of the screw problem, presents a certain analogy to the general method of solving problems of the theory of elasticity. At one time, scientists tried to deduce the elastic properties of solids starting from the hypothesis of the molecular structure of bodies. But the real progress of the theory of elasticity was only obtained when this risky method was abandoned.

In order to establish the elastic properties of solids, the modern theory of elasticity has recourse to direct experiment, and based on the data of this latter, it connects the complex cases with the simple by the help of the fundamental propositions of mechanics. This, in my opinion, is what should be done with regard to the solution of the problem of hydrodynamic resistance. Find out the factors which depend on the physical nature of the fluid and the surfaces in contact, and for their numerical value fall back on direct experiment. But from the knowledge of these factors, once they are determined, the results that mechanics allow of being established must be drawn.

The methods which have been proposed for the solution of the problem of the hydro-dynamic resistance of fluids have as a rule the following scheme: First of all, the fixing of the fundamental characteristics of the stream around the solid in motion is sought. Then the distribution of velocities in the fluid mass is determined; from these latter we go on to the pressures of which the results on the surface of the body ought to represent the hydro-dynamic resistance of the fluid. Thus Euler's method consists in supposing the flow of the fluid to be continuous and allowing a potential function for speeds.

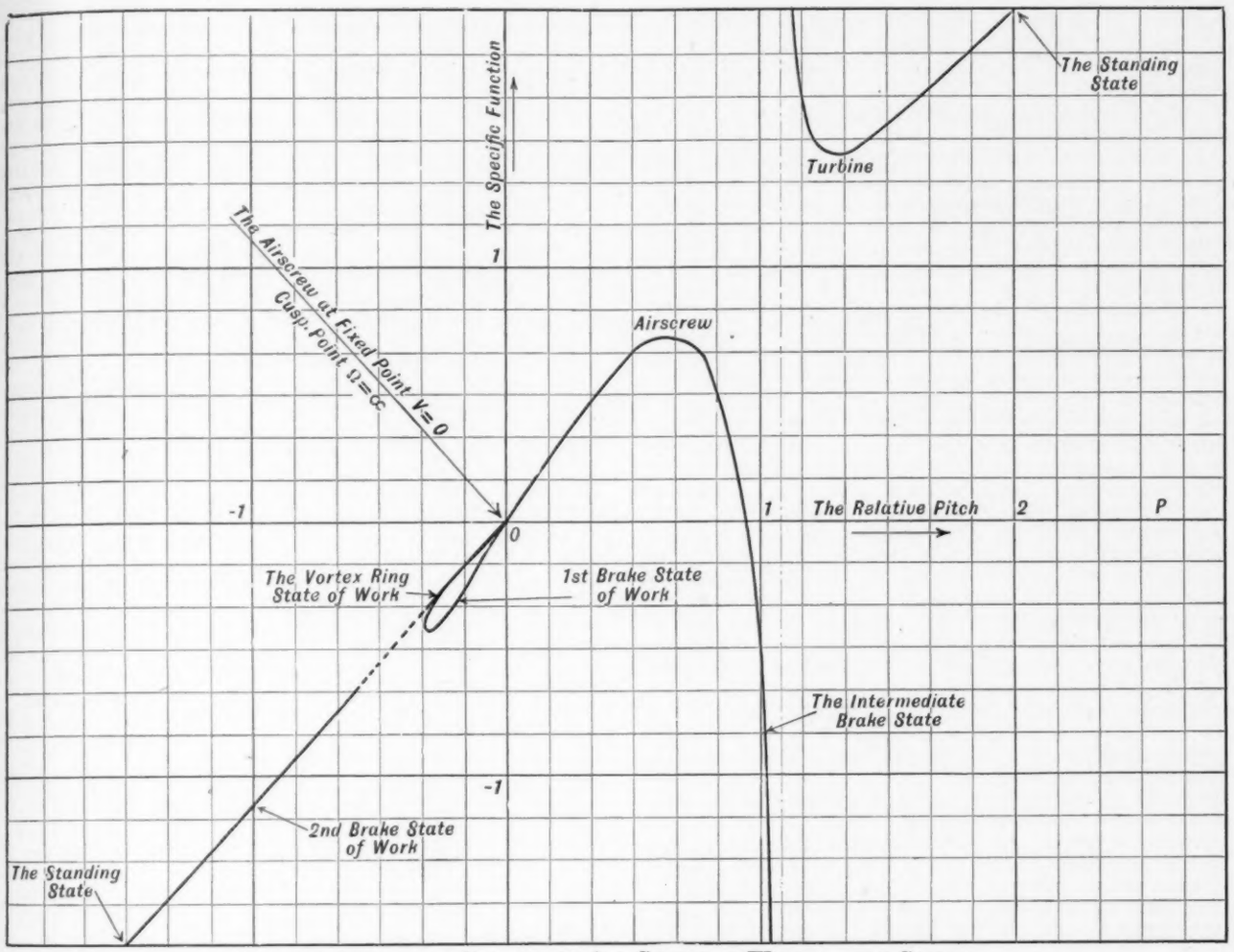
This conception of the phenomenon leads to the conclusion that all bodies immersed in a fluid do not show any hydrodynamic resistance, which is in flagrant contradiction to experience. In order to explain the phenomenon of resistance, Helmholz has supposed the formation, behind the body, of surfaces of discontinuity, to which he had been led in studying the flow of fluids through orifices. This method has been developed by Kirchoff and Lord Rayleigh. The value of the hydro-dynamic resistance obtained by this method is, however, inferior to that furnished by experiment. The cause of this divergence lies in the fact that this type of flow is unstable, the viscosity of the fluid destroying the surfaces of discontinuity.

Of late years, M. W. Kutta[2] having established, in the case of movements parallel to a plane, the relation between the circulation over a definite outline which encloses a cylindrical solid and its hydro-dynamic resistance, tried to determine this latter by studying some types of flow of fluid around the solid, which, although stream-line, furnishes a definite value of the circulation around the cylinder. To Messrs. Tchapliguine and N. Joukowski[3] we owe numerous developments and applications of this method. The authors of this theory have been able to calculate the lift furnished by the cylindrical solid, but a value which does not agree with experiment, namely, the drift, escaped their investigations. I shall therefore en-

[1] The whirling phenomenon is often observed in the braking of ships by means of the screw. At that moment a sudden jerk on the engines is observed, and the engines themselves tend to accelerate. In practical navigation this phenomenon has always been considered as accidental. It is however, quite a regular phenomenon, which detects the moment of change in the direction of the stream of water which flows across the screw.

[2] See W. M. Kutta, "Illustrirte Aeronautische Mittellungen," 1902. "Sitzungsberichte der Koeniglichen Bayerischen Akademie der Wissenschaften. Münich, 1910 and 1911.

[3] See *L'Aérodynamique* de N. Joukowski. Paris, 1916. Chap. VI, paragraphs 18, 19, 20.



GENERAL ANALYTICAL DIAGRAM OF ALL STATES OF WORK OF THE SCREW

deavor to give a general demonstration of the theorem of circulation which explains this misunderstanding.

This theorem does not furnish a nil value of the drift and its authors arrived at this conclusion only by the fact of supposing the fluid to be perfect, an hypothesis quite superfluous and entirely unnecessary for establishing this theorem. But this theorem itself, understood in its widest sense, does not lead to the solution of the problem of hydro-dynamic resistance, since the values obtained for the circulation depend on the type of flow supposed, and which always remains to be determined. This latter question, of the type of flow, is excellently stated by M. v. Karman,[4] who proposes to determine the hydro-dynamic resistance starting from the estimate of the momentum of the vortex in quincunx, which is formed behind the cylindrical solid in uniform rectilinear motion in a fluid. This theory, applied up to the present only to the most simple cases, gives results which agree better with experience.

All the attempts enumerated above, although quite erudite, cannot give us the value of the hydro-dynamic resistance for all the cases demanded by technique, and we are always obliged to resort to experiment for its determination. How ought we to proceed when a problem of hydro-dynamic resistance bars the way to our investigations? It is by the empirical-theoretical method that I find the means of circumventing this difficulty. This method really consists in reversing the question.

We do not propose to calculate the hydro-dynamic resistance from the type of flow of the fluid, but inversely, it is the flow of the fluid that we shall try to determine, starting with the knowledge of the hydro-dynamic resistance measured experimentally. In general the empirico-theoretic method is represented as follows: All the space in which a hydro-dynamic phenomenon has played is divided into two sorts of regions. In one of these the hydro-dynamic resistances are, so to say, concentrated; in the other, they are absent. The hydro-dynamic resistances once experimentally determined, the connection between the two sorts of regions is established by means of the general theorems of mechanics and hydro-dynamics, the phenomena which take place in the second sort of regions being considered as under the laws of perfect fluids.

Returning to the general considerations of our screw problem I shall begin by defining this problem. As for all conceptional definitions this will only approximate reality to a certain degree. But the value of our method of formulating the problem lies in the fact that it leads us to a solution of this latter, which satisfies all the demands of the technique of the application of the screw.

The following, in accordance with the empirical-theoretical method is my conception of the screw problem. In order to fix our ideas we will allow that it is a propeller. I divide the stream of fluid into three regions. The first is that part of the stream which is placed forward of the screw and counted up to the section of the stream that the local phenomena caused by the rotation of the blades in the field have not reached. The second region, which contains the screw, immediately follows the first and encloses that part of the stream immediately disturbed by the rotation of the screw-blades. I determine this second region by the condition that the differences of pressures on the two limited sections is actually equal to the thrust produced by the propeller. The third portion is the direct prolongation of the second and extends up to the narrowest section of the fluid created by the whirl of the screw. I allow that the flow of fluid in the first and third regions obeys the laws of perfect fluids, while the phenomena taking place in the second region are estimated by globular estimation, by direct experiment. As regards the fluid stream from the third region, I allow that its speed is progressively reduced by the viscosity of the fluid. The conditions enumerated above are the *normal conditions of the working of the*

[4] See v. Karman, "Nachrichten von der Koeniglichen Gesellschaft der Wissenschaften zu Göttingen," 1911. "Physikalische Zeitschrift," 1912.

screw. I call all the circumstances which deviate from normal conditions, *neighboring conditions.*

The conception of a problem can only be judged by the conclusions to which it leads. The results obtained by my theory, I hope, will be the most eloquent evidence in favor of my conception of the screw problem. I should like to mention that it has been quite impossible for me to deal with all the questions that my conception of the screw problem raises. I have concentrated my efforts above all on the problems which appear to me to be most important practically and the results I have obtained should suffice for the exact calculation of screws of the highest efficiency for states of working which I submit to detailed study.

I also wish to point out to those about to verify the present theory by experiment, two circumstances which disturb, as it were, the clearness of the phenomena: on the one hand, the deformation of the screw-blades, and on the other, the deviations of fluid resistances from the law of the square of velocities. It very often happens that when the angular speed of the rotation of the screw is increased, the blades undergo a certain distortion owing to the strain to which they are submitted. This causes a modification in the pitch of their sections which gives an immediate repercussion in the results of testing.

As for the law of the square of velocities, it can only be considered admissible in the first approximation, that is why it can only be applied at certain intervals of variation of velocity for which the co-efficients of resistance ought to be directly determined. When the co-efficients of resistance are taken as constant in the long intervals of variation of velocity, the results of the calculations raise differences which should be attributed to the deviations from the law of the squaring of velocities.

In conclusion I shall give a general summary of the chief results obtained at this time by my theory. The system of fundamental equations relating to the screw are first established. The theorems of momentum and of moments of momentum in their application to the screw are then examined, after which a complete picture of the movement of the fluid in the stream created by the rotation of the screw is given. The examination of the distribution of pressure in this fluid stream leads to the generalization of Bernouilli's theorem. It is shown that the *effective pitch* alone, as opposed to the *constructive pitch,* can serve to describe the properties of the screw. The fundamental theorem registering the losses in the work of the screw is established. The explicit expressions of the velocities in the fluid stream caused by the rotation of the screw, which I call *additional velocities,* are calculated both forward of the screw and in its wake—as functions of the dimensions of the screw and the co-efficients of resistance. Rigorous demonstration is given of the fact already known, but generalized by us, that the specific function is a function of the relative pitch alone.

The general discussion of the sixteen states of work which may be fixed for the screw is given afterward. The existence of the state of the vortex ring, as well as of the phenomenon of whirling, which enter the screw theory are submitted to general analytical examination. The general outline of the curve of the specific function is examined. Finally, I point out two limit cases of the work of the screw with a null constructive pitch and of the screw with an infinite constructive pitch. The consideration of the effective pitches immediately explains the paradoxes apparently realized by these cases.

After these general considerations I shall undertake the study of the propulsive screw. First of all, I shall give a comparative summary of the general formulae for the working of the screw when alvancing and when standing at fixed point. I thus establish the fundamental proposition that *when a screw is working at fixed point the angles of attack of all sections are constantly independent of the angular velocity of the rotation of the screw.* Then the losses of the screw's working power are estimated. These I divide into three classes: Loss in ventilation, loss in the vortexes, and loss in resistance. The most favorable working conditions of an element of blade are established. I establish the approximate proposition that when an element of blade works at its maximum of partial efficiency, its slip measures its loss, its efficiency is equal to its relative pitch. *An exact standard is given for choosing the most efficient shapes to adopt for screw-blade sections.* I deal with the question of the limit dimensions of blades, their limited number and their mutual influence. It is shown that for given conditions of working there exists a limit power that a screw can employ usefully. In the analysis of these questions the new notion of fulfilling is naturally evolved.

Among other experiments, those of M. Eiffel with two coupled screws, the nearing of which in the inverse sense of their rotation had increased the efficiency, finds a direct explanation. I then proceed to the summary valuation of the work of different sections of the blades. A geometrical interpretation is given to the problem of total efficiency, which establishes the direct relations between the partial and the total efficiencies. I examine the question of the effective pitch of the entire screw, and then pass to the integration of the work of different sections of the blade, with data of the different conditions which may be found in this integration. After an examination of certain properties of the integrals obtained, I compare the working of the propulsive screw in forward motion to its working at a fixed point.

The question of investigation of the best contour for blades is posed as a question of the calculus of variations. The problem of the calculus of the dimensions of propulsive screws is made the subject of detailed study. In order to solve the fundamental relations deciding the value of the angle of attack, which is effectively established in each section, and cannot be solved by ordinary methods, I have composed a monogram with four parameters, according to M. d'Ocagne's method of parallel tangent co-ordinates. A second monogram has been prepared in order to facilitate the calculus of the function az, and of the co-efficient of load q, but which evidently has not the importance of the former, since the relations for which it gives numerical values may be calculated directly. The problem of the calculus of propulsive screws is thus entirely solved in the widest sense for all practical demands.

Finally, I deal with the important question of the choice and adaptation of screws. I am led to establish the new notion of *uniform families of screws* divided into *varieties.* Up to now this has generally been limited to screws geometrically alike. I introduce the notion of the screws, which are, so to say, hydro-dynamically alike.

Passing to the comparison of screws among themselves, it is natural to imagine the different sections of blades in like working conditions, then we naturally come to functional relations connecting all screws of the same variety. Hydrodynamic similarity is established when homologous sections of the blades of the screws of a family under consideration are geometrically alike, and when the fluid-current is directed upon them under the same incidence. It is thus that the notion of variety of a uniform family is revealed as characterized by the similarity of homologous sections of blades, independently of their effective pitch, and by the identity of the system $S(i)$ of effective angles of attack of all the sections of each blade of these screws.

But the introduction of the system of angles of attack $S(i)$ as a fundamental characteristic became possible when explicit relations were established between the effective angles of attack, the geometrical and hydro-dynamic characteristics of screws and their working conditions, results attained for the first time in this thesis. That is why we can now fix exactly in this way the mutual orientations of different sections of the blades to which those developed in the plane are geometrically similar. It is the latter possibility which renders the basis of the theory of uniform families and which leads us to the solution of the delicate problem of the choice and adaptation of screws. I divide the screws into three sorts—major screws, optima or maxima screws, and minor screws, all of which essentially differ in their general properties. I establish three fundamental relations connecting all the screws of one kind and allowing of a direct solution by the reading of a simple diagram of all the infinite series of screws which satisfy the conditions of velocity, power and number of revolutions for a given case.

I indicate the process of *the auxiliary trial (test) screw.* For choosing the propeller screw in cases when the drift or head resistance of the vehicle of locomotion in view is unknown, which is most usually the case in practice. The influence of the number of revolutions on the efficiency and dimensions of screws is examined in outline. The geometrical basis of the conventions used for screw design are also given.

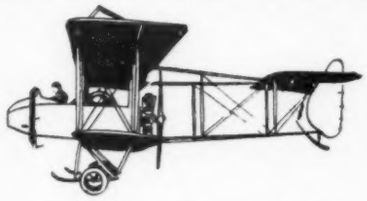
The general theory of the screw leads to a new method of determining the co-efficients of fluid resistances based on the properties of the screw. This method forms, so to say, the basis of all the experimental data necessary for the calculus of screws in the same conditions of screw-working.

The Evolution of the Airplane*—*Concluded*

By C. G. Grey
Editor of The Aeroplane

The Henry Farman of 1913

In the Henry Farman of 1913 we find the "pusher" design crystallizing into its ultimate form. The whole machine has become neater and more compact. The nacelle shelters the pilot reasonably well. The tail, elevator, and rudder form an



THE HENRY FARMAN, 1913

eyeable unit, and the general effect is more workmanlike and less spread-eagled. This type was ultimately combined with the "Shorthorn" Maurice Farman into a composite machine nicknamed the "Horace"—a jesting combination of Henry and Maurice—which was doing good service in 1917, as a means of training and aerial travel rather than as a fighting machine. The 1913 type was a distinct step toward the Vickers and F. E. gun-'buses.

The Sopwith Tabloid of 1913

Here we have a machine which marked a startling development. T. O. M. Sopwith, himself a brilliant pilot; Mr. Hawker, a clever Australian pilot, and Mr. Sigrist, Mr. Sopwith's chief engineer, produced early in 1913 a tiny tractor biplane, with an 80-hp. Gnôme engine, which startled the aero-

THE SOPWITH TABLOID

nautical world by doing a top speed of 95 miles an hour, while possessing the ability to fly as slowly as 45 m.p.h. The result was obtained by skillful reduction of weight, by careful streamlining of external parts, and by close attention to wing design.

It was the first high-speed biplane, for hitherto monoplanes had always been considered faster than biplanes. All the high-speed fighting biplanes of today—"Scouts," "Pups," "Camels," "Bullets," "Dolphins," "Hippos," "Snipes," "Hawks," "Elephants," "Squibs," "Kittens," "Babies," "Schneiders," "Bats," and others with fancy names coined affectionately for them by their designers and pilots, descend in the strictest genealogical tree from the original "Tabloid," so called because it contained so much concentrated excellence.

The 80-Avro of 1914

Following soon after the "Tabloid" came a new Avro, which remains today one of the most remarkable of airplanes. A large two-seater, with only an 80-hp. Gnôme, it put up a speed

THE 80-AVRO, 1914

of well over 80 miles an hour. As a war machine early in the war it did excellently. Three bombed Friedrichshafen with success. Today, with but slightly higher power, it is the best of all training machines. Among two-seater biplanes it marked as great an advance as did the "Tabloid" among single seaters, and for the same reason. Careful lightening, without loss of strength, and careful stream-lining.

The Vickers Gun 'Bus of 1914

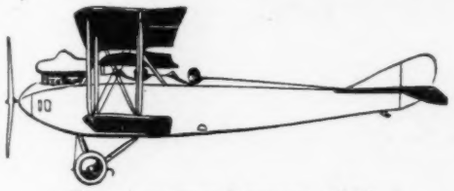
Also, early in 1914, came the first genuine gun-carrying biplane, designed and built by Vickers (Limited). Obviously of Farman inspiration, or descent, it had a specially strong nacelle, to stand the working of the gun. With a 100-hp.

THE VICKERS GUN 'BUS

Gnôme, its speed was over 70 miles an hour. It was universally known as "The Gun 'Bus," and the name stuck to the whole class.

The Albatros Biplane of 1914

Another development of 1914 was the Albatros tractor biplane, with a six-cylinder vertical water-cooled Mercédés

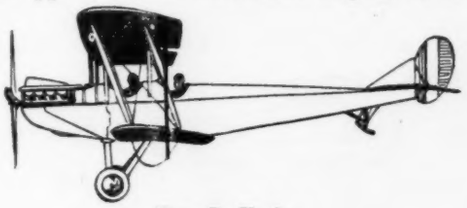


THE ALBATROS BIPLANE, 1914

engine of 100 hp. This was the ancestor of all the big German tractor biplanes up to the present day. It, and they, are descendants obviously of the Bréguets and Avros of 1910.

The B. E. 2c of 1914

Just before the war the Royal Aircraft Factory produced an uncapsizable biplane nicknamed "Stability Jane." Her official title was the B. E. 2c, this being the third modification (c) of the second type of Mr. de Havilland's original B. E. When



THE B. E. 2C.

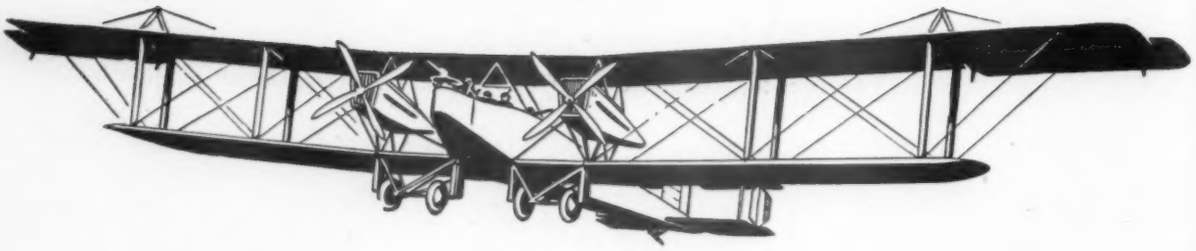
once off the ground the machine flew itself, and the pilot had only to keep it on its course. Though slow in speed and in maneuvering, the type was useful for certain definite purposes, and with further modifications it survives today, and does all that the Taube set out to do, with less waste of power.

The Twin Caudron of 1915

Though various experiments had been made with airplanes with more than one engine, and though many were designed in 1914 which afterwards made good, the first to fly regularly and with consistent success was the twin Caudron, with two 110-hp. Le Rhône engines. It may therefore claim to be the first twin-engined machine.

THE TWIN CAUDRON, 1915

*Courtesy of the London *Times*.



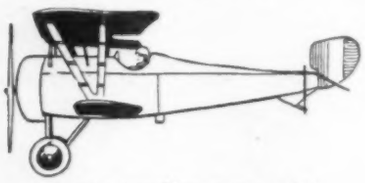
THE HANDLEY PAGE, 1916

The Handley Page Twin of 1916

Closely following it came the huge Handley Page biplane of 1916, with (at first) two Rolls-Royce engines of 250 hp. each. Like everything else in the war, they have since gone up, and the power is now far higher. One of these machines in 1916 took a pilot and 20 passengers to a height of 7000 ft., and in 1917 another flew from London to Greece and then bombed Constantinople.

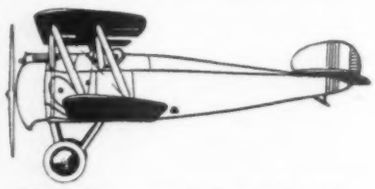
The 1916 Nieuport

The most noteworthy of the small machines of 1916 was the Nieuport biplane, with the 90-hp., and later the 110-hp., Le



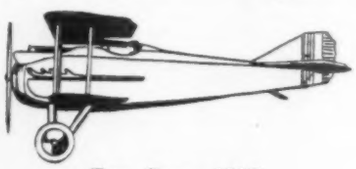
THE BABY NIEUPORT, 1916

Rhône engine. This was an excellent fighting machine, and a direct successor of the "Tabloid." It was remarkable for the curious V formed by the struts between the wings.



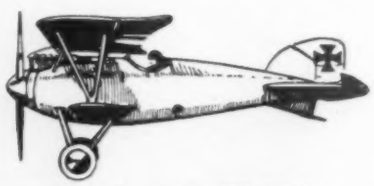
THE SOPWITH "CAMEL," 1917

Virtually there is only a single spar to the lower wings, so that it is more of a 1½-plane than a biplane. The Germans



THE SPAD, 1917

copied this single-spar idea in their Albatros single-seat "chasers" of 1917.

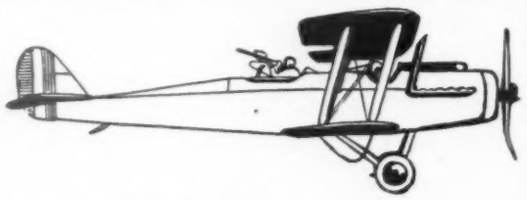


THE ALBATROS III, 1917

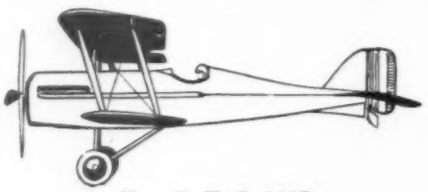
The Machines of 1917

The year 1917 is still too close for one to give many particulars about the outstanding features of its machines, but one may mention those which are known to be familiar to the enemy, and one may illustrate their outlines to show how they compare with the older types, and thus be enabled to note the line of development.

Here we have the Sopwith "Camel"; the Spad, designed by M. Béchereau, of Deperdussin fame; and the Albatros, D.iii type—all obviously descendants of the Nieuport and the Deperdussin, and the Tabloid. Also we have the de Havilland 4, built by the Aircraft Manufacturing Company (Ltd.), and designed by Captain de Havilland, as he now is; and we have the S.E.5, built and designed by his successors at the Royal

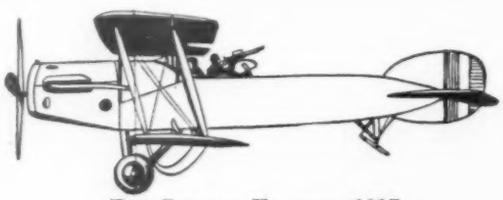


THE DE HAVILAND 4, 1917



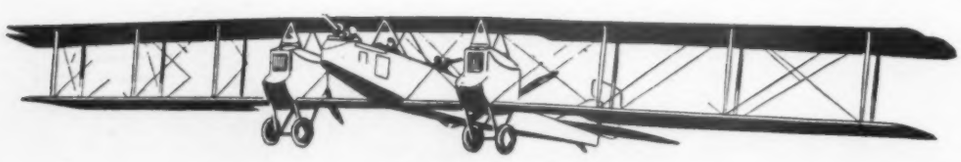
THE S. E. 5, 1917

Aircraft factory, both descendants of the B. E. Then there is the "Bristol Fighter," built by the British and Colonial Aeroplane Company, of Bristol, and designed by Captain Barnwell, a pioneer of flying in Scotland, who built a machine of his own in 1909. It shows traces of the 1910 tractor biplanes.



THE BRISTOL FIGHTER, 1917

Finally we have the Gotha Bomber, of evil renown, a descendant of the Caudron and Handley Page twin-engined machines. Italy has produced the vast three-engined 1000-hp. Caproni triplane, but its sheer size prevents it from being illustrated to scale. And so we have in review practically all the salient steps in the development of the airplane from its earliest successful effort to its most modern types.



THE GOTHA, 1917

Some Problems of Airplane Design

By B. Russell Shaw

In this Era of Aviation when we are needing and building thousands of airplanes, there have come into the field many so-called airplane designers and aeronautical engineers. The experience of these men has been mostly perfunctory, if any, and they are constantly arriving at some conclusion or design which the past experience has proven inadequate or incapable of standing up under hard usage and actual flight conditions.

We require genuine aeronautical experts. Men who have made it a special study from the beginning of aviation. They may not be college graduates or masters at mathematics but should have sufficient knowledge to make all stress diagrams and performance charts. Above all, those who have gone through the building up of the industry are particularly fitted

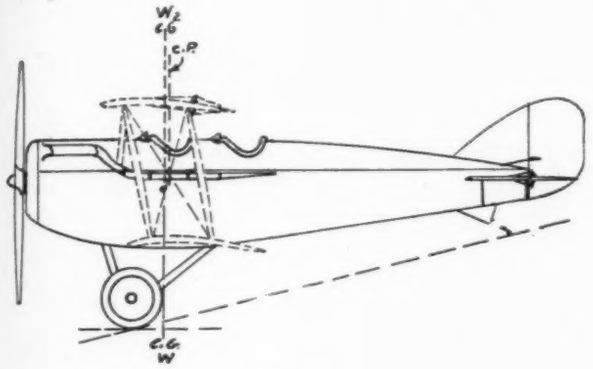


FIG. 1

to act as practical builders and designers. It requires airplane men to construct this mighty fleet of airplanes; not men from different trades in the automotive industry.

Practically all the newcomers talk of is the factor of safety, and what after all is this thing? The incident of the famous St. Lawrence River bridge which had the very best engineering in the world figuring its strength, and yet collapsed twice, is proof of that old saying: "The so-called factor of safety is only a factor of ignorance." These methods are nevertheless the ones to be used now; but to prevent its being a factor of ignorance we must use fundamental factors of experience.

A few of the most common mistakes of these newcomers that have come to the writer's notice are the following:

A procedure often poorly followed in designing an airplane is the correct balancing of the component parts and giving them the correct relation with the center of pressure.

Some designers draw the complete machine, locate the center of pressure and center of gravity, then give them the correct relation by shifting such weights as the pilot and passenger or the gasoline tank. This method is very poor inasmuch as it does not allow the body struts and ties to be attached at the proper places. The gasoline tank should be given as nearly neutral position as possible, and not shifted.

The seats should not be moved, for once a proper and comfortable arrangement is reached that arrangement should remain as any moving from this point may cause cramping in an unnatural position. The body should be laid out complete, taking into consideration the range of vision of the pilot. If he is to be placed in front as in some European machines then the gunner in the rear seat must have ample room for action. It is sometimes an advantage to have two seats, one above the other so that the top one may be folded up allowing him to sit almost on the floor of the body for observation, camera work or bomb dropping, through a door in the floor.

The center of gravity of the entire body assembly is found by a very simple method shown in Fig. 3. The weights of the component parts are multiplied by their respective distances

$$AA_1 + BB_1 + CC_1 + DD_1 + EE_1 + FF_1 + GG_1, \text{ etc.}, = \frac{W_1}{W}$$

The first distance A being anything desired. W = the total weight of all component parts in the body assembly.

After this is done the wings should be considered. They should be drawn upon a separate sheet and the resulting C. P. and C. G. determined, allowance being made for the extra efficiency of the upper plane affecting the combined location of the C. P.

The wings are then placed on the body and shifted until the desired relations of C. P. and C. G. are obtained. This will apply to a neutral tail setting. If a positive or negative tail is used, the forces actuated by it must be taken into account. The resulting forces caused by the leverage between the C. P. or K_y and the C. G. or W, as well as those between the lines of thrust and resistance, must be gone into very carefully when setting the tail plane so that the proper degree of longitudinal stability may be obtained.

FIG. 2

There are several things to consider when placing the controls, of which a few are often slighted. They must, above all, be strong and well made. In the case where the stick is used with a universal at the lower end this should be wide enough to give plenty of leverage on the bearings; these should be bronze bushed and large enough to take the constant wear.

The rudder bar should be long so that ease of action may be attained, and also to allow plenty of leverage for a hard pull as in recovering from a spin. It is well to place small retainers projecting on each side of the foot-bar, to prevent slipping. These should be made integral with a foot corner plate to cover the edge of the bar and to take the wear, instead of the common practice in which the shoe wears away the wooden bar and makes a very shoddy-looking job. Allow plenty of bearing area in the bar, as this undergoes more wear and abuse than any other control. In case of a nose smash, the pilot is sure to brace himself against it and take most of the shock in this way.

Always place the controls in a comfortable position so the pilot in a long flight will not be cramped. The instrument

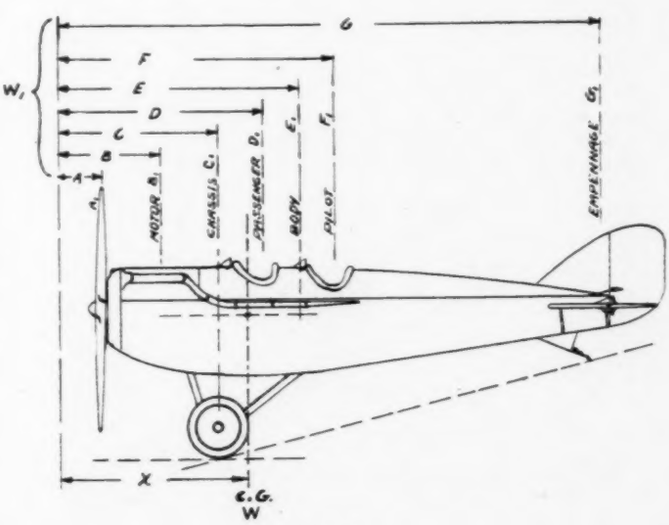


FIG. 3

board should not be placed so low that the pilot will strike it with his hands or knees.

In a number of European machines a small quadrant, with ratchet lock, is provided on the stick, that the pilot may have both hands free to make notes or "pull the gun." This is never done on training machines, for the pupil may lock the control and become confused, which may result in an accident. It is used only where real war work is to be done.

The spark and throttle controls must be in such position that they can be easily and quickly reached by a most natural

movement from the stick. The controls are usually placed on the upper right longeron, about six inches ahead of the neutral position of the stick. Care should be taken that the spark and throttle are separated far enough to prevent fouling in a quick move. They should be held by friction or by a very easily moved ratchet.

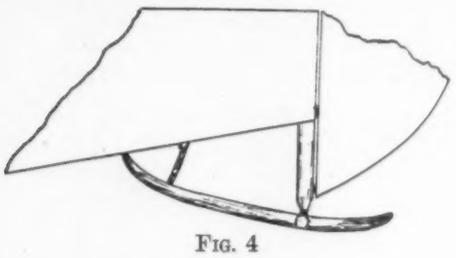


FIG. 4

Several accidents and near accidents have been caused in using the standard wheel yoke control, due to the pilot's or passenger's coats jamming between the yoke and the side of the body and seat. This should be carefully considered and every precaution taken to guard against this cramped position when a yoke is used.

In designing the instrument board, the instruments should be placed within easy view of the pilot. It is advantageous to supply a small electric light, if possible, to illuminate the instruments.

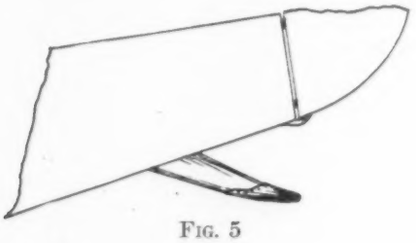


FIG. 5

If there is not plenty of shoulder room around the cockpits and the padding is too large, it will interfere with ease of seating and observation.

A very common thing around aviation camps is fire on board, due to a back fire, generally caused by altitude changing the mixture. In Europe they are using a carbon tetrachloride spray, which has a grip along the right side of the body, and when fire breaks out it is only necessary to grab this handle and, by a few strokes, completely fog the motor compartment. It sometimes happens that by this one move the spark is cut and the gasoline shut off automatically. The

FIG. 6

mere placing of an extinguisher in the body is insufficient, for it cannot be shot under the hood while flying, unless through a hole in the fire board back of the motor.

One of the most common practices is to taper the body longtitudinals. This is convenient from an aerodynamical standpoint, as it reduces weight. However, for production it is poor, inasmuch as it means that all fittings and all struts back of the pilot must be of different size. It is a very slow and expensive operation, but worthy of consideration.

Veneered bodies are rapidly finding favor among several of the foreign constructors, due to the ease of manufacture, smaller number of parts, elimination of a large number of fittings, wire and its great strength. It is almost certain that we will see this method of construction coming into fairly common use where great production is desired.

The proper position of the wheels in the landing gear is a very serious problem, and one which should have a great deal of study. A number of designers believe that by placing the wheels twelve or sixteen inches ahead of the C. G. they are doing all that is necessary, but they fail to take into account the other forces resulting from this setting. If the wheels are placed too far ahead a heavy load is placed on the tail skid. This not only strains the body, but causes rebounds when landing, making the machine hard to handle on the ground. Again,

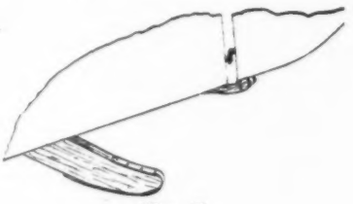


FIG. 7

if the wheels are near the C. G. they cause a nosing over tendency which may result in many smashed propellers or a complete turn over.

A tail skid must not be made too flat, as is shown in Fig. 4, but should be more in the form of a tusk, as shown in Fig. 5, to allow a quick stop after landing. The end should be protected by a shoe, Fig. 6, and not a strap, Fig. 7, as the strap gives no protection to the wood on each side and soon wears through.

The swivel mounting should be very well designed to take side thrusts and be made amply strong. Thin sheet stock used at this point has the result that the skids are constantly laying over and have to be replaced. A few foreign machines use light leaf springs carried in a casting within the body or in a veneer housing extending below Fig. 8. This eliminates all forms of swivel joints, shoes and shock absorbers.

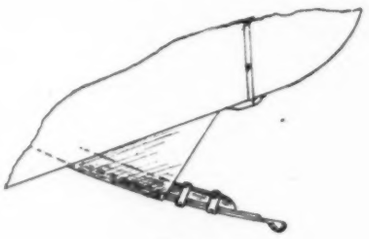


FIG. 8

An item which received no little criticism at the hands of European inspectors is the large gap commonly found on our machines between the top of the body and upper plane. This allows a great deal of "weaving" tendency and resistance, and makes a spindle-like job. However, our newer designs are showing marked improvements along this line.

A great saving can be obtained by stream-lining the cables wherever possible. In fact, by doing this on all exposed cables, on the average seventy-five-mile-an-hour machine a saving of as much as ten horsepower may be gained.

Aeronautical Patents

ISSUED APRIL 2, 1918

1,261,663—To Karl H. Weidhase, Chevy Chase, Md. Airship.
1,261,731—To Clarence E. Fronsdahl, Slater, Iowa. Kite.

ISSUED APRIL 9, 1918

1,262,313—To William H. J. Downey, Wilmington, Del. Aerial toy.
1,262,535—To George W. Mann, Pierce City, Mo., assignor of one-half to Emmert C. Block, Sarcoxie, Mo. Airship.

ISSUED APRIL 16, 1918

1,263,192—To Otto M. Bergman, Rochester, N. Y. Hydroaeroplane.
1,262,834—To Giovanni Norerti, Boston, Mass. Airplane.
1,262,660—To Edson F. Gallaudet, Norwich, Conn., assigner to Gallaudet Aircraft Corp., New York, N. Y. Airplane.

The Model C.V Albatros Biplane*—*Continued*

The upper planes are attached, as in nearly all German machines, to a four-legged cabane. In addition to supporting the wings the cabane of the Albatros carries the radiator, which is of the same shape as the wing section and which fits into an opening in the wing. The cabane is shown in Fig. 33. It will be seen that one of the cabane legs carries for a short distance the water tube from the radiator of the engine.

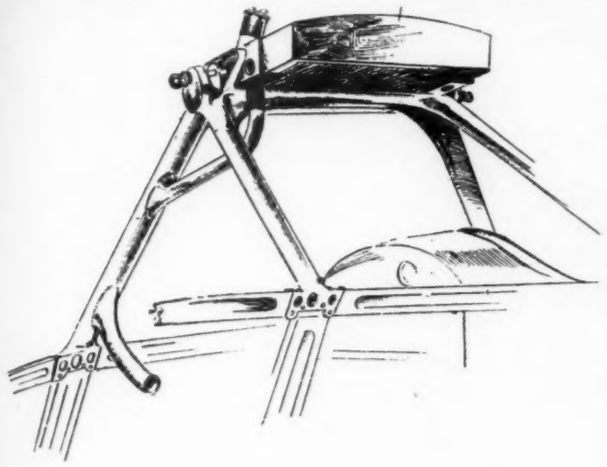


FIG. 33. THE CABANE SUPPORTING THE RADIATOR, SET INTO THE UPPER PLANE

The attachment of the upper wing spars to the cabane is somewhat similar to that of the lower spars, inasmuch as a pin fitted with a spiral spring secures the spar to the cabane. Here, however, the similarity ceases. Instead of the spar box into which fits the lug on the side of the body, the upper spars are provided with a forked lug, probably a forging machined to shape, of the form shown in Fig. 34. The lug of the opposite spar is of the same shape, but is, of course, reversed, so that when the two spars meet against the top of the cabane, their respective lugs are staggered in relation to one another. From the shape and attachment of the lugs it will be seen that as they are staggered on the spar and in relation to one another, the spars will, when in place, come in line with one another. On one of the outer faces of the forked lug a piece is left solid and is shaped to receive the rounded end of the opposite lug. This has probably been done in order to reduce the shearing stress on the pin securing the lugs to the cabane.

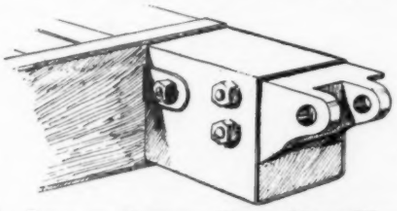


FIG. 34. LUGS ON ROOT OF UPPER MAIN WING SPAR

In a previous issue reference was made to the lateral control of the Albatros, the chief feature of which was, it may be remembered, that the wing-flap crank lever was horizontal, as in so many other German machines. The control cables for the wingflaps are, therefore, arranged in a somewhat unusual way. The details of this arrangement are shown clearly in Fig. 37. From the front and rear half of the wing flap crank lever cables pass down to pulleys enclosed in a casing mounted on the rear face of the back spar of the lower plane. After passing over these pulleys the control cables pass through the rear spar to another pair of pulleys mounted on the tubular compression strut, and hence to the controls in the body. A light framework surrounds the pulleys as shown in the sketch, and forms the support for the hinged inspection doors by means of which the condition of the pulleys and control cables may be examined. The tension of the wing-flap control cables is regulated by means of turnbuckles inside the lower wing. These turnbuckles are situated close to the side of the body, and are rendered accessible by hinged aluminum inspection doors on the lower surface of the bottom wing. In order to prevent the turnbuckles from catching against the edges of the wing ribs, cables and turnbuckles are surrounded by a tube of aluminum having on its under side an opening with edges flanged outwards to reduce the danger of a slack control cable allowing the turnbuckle to touch the edges of the opening in the tube.

As in the majority of modern tractor airplanes, the undercarriage of the albatros is of the Vee-type and is built of stream-line steel tubing throughout. The general arrangement of the undercarriage is shown in 1, Fig. 36, from which it will be seen that only the front pair of undercarriage strut are diagonally braced by cables. Reference has already been made to the claw brake, and to the manner in which it is operated from the pilot's cockpit. In the sketch its general arrangement will be evident. The front and rear struts of the undercarriage fit into split sockets at the top and bottom respective-

FIG. 35. THREE-QUARTER FRONT VIEW OF THE ALBATROS C. V.

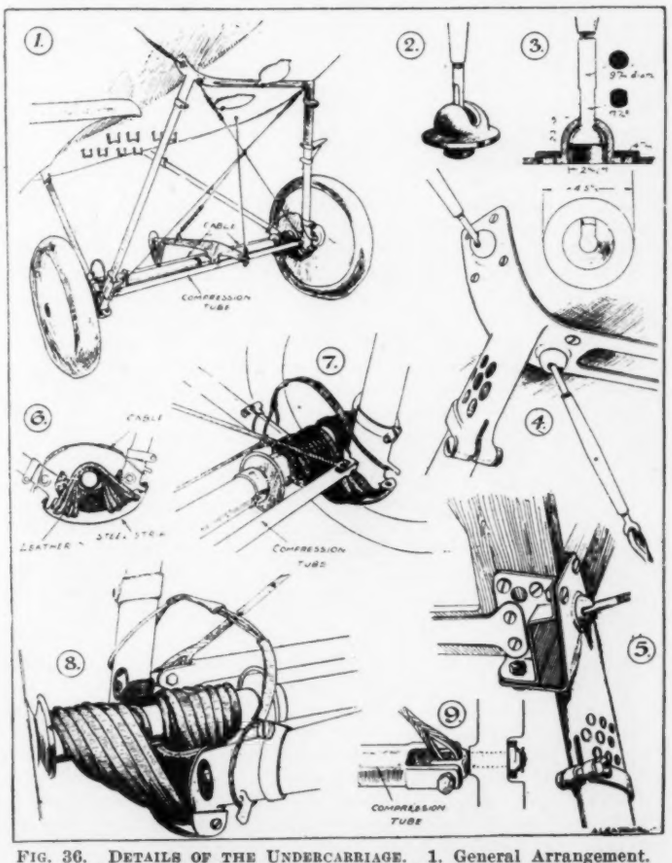


FIG. 36. DETAILS OF THE UNDERCARRIAGE. 1. General Arrangement. 2 and 3. Details of Cable Terminal. 4. Steel Strip Passing Under Body. 5. Attachment of Rear Chassis Struts to Body. 6. Lower Attachment of Chassis Struts and Shock Absorbers. 7, 8 and 9. Details of the Same.

* Courtesy of *Flight*.

ly, from which they may be withdrawn by undoing the bolts of the socket, thus facilitating replacement in case of damage due to a rough landing.

Front and rear strut sockets are attached to the body in a slightly different manner, as will be seen from the sketches of Fig. 36. In the case of the front strut sockets these are welded to a wide steel trip passing underneath the bottom of the body, thus tending to distribute the load over a greater area of the body. The details are shown in the general arrangement sketch, and in 4, Fig 36. Just inside the strut socket the cup-shaped terminal for the diagonal bracing cables of the undercarriage is secured, while a short distance above the

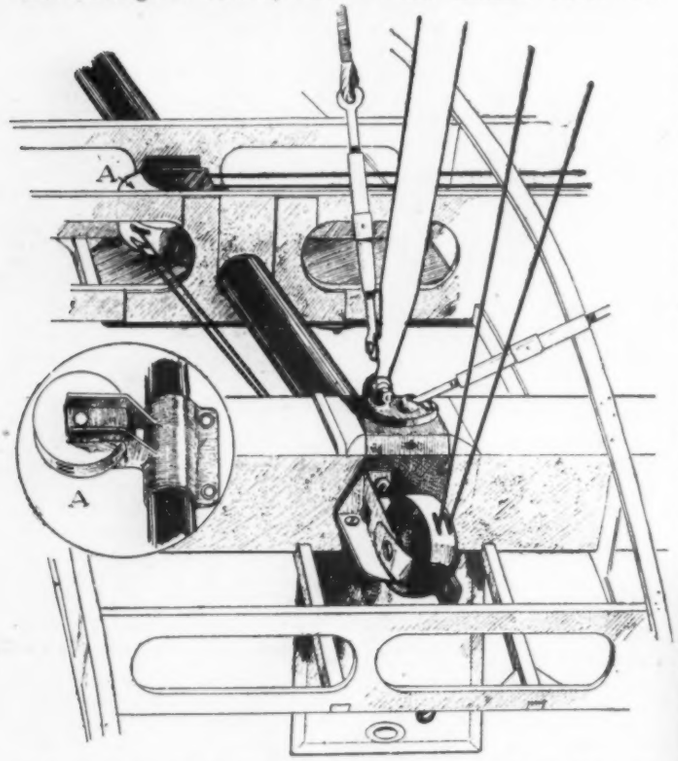


FIG. 37. GENERAL ARRANGEMENT OF WING FLAP CONTROL CABLE PULLEYS IN THE LOWER WING

socket is situated the attachment for one of the main lift cables. This ball and socket joint, which is used with slight variations on nearly all German machines, appears to be almost the only fitting that may be truly said to have been standardized by the Germans. It is made in a range of sizes, no doubt all made to some uniform standard so as to render it applicable to a number of different types of machines. The details of the fitting are indicated in 2 and 3, Fig. 36. The base plate securing the hemispherical socket to the body or whichever part of the airplane the terminal happens to be attached to, is recessed, probably by stamping, and into this recess fits the flange of the socket. The socket itself is free to turn in the circular recess of the base plate thus allowing the cable to accommodate itself to any angle desired. The end of the turnbuckle has two flats on its shank which prevent the strainer from turning. For purposes of adjustment the slot in the socket is enlarged at its inner end so as to allow the strainer to turn when in a position at right angles to the base plate.

The attachment of the rear chassis strut to the body is shown in 5, Fig. 36. The base plate to which the strut socket is welded is of angle section, and is secured, via brackets as shown, to steel strips running across the body, and which take the tension of the lift cables. This arrangement is somewhat similar to that of the lower wing spar attachment which was described before.

The lower ends of the two Vees are formed by short lengths of bent tube of slightly larger dimensions than the struts themselves, for which they form sockets. Running across the undercarriage parallel with the axle are: in front a compression tube, and behind a stranded cable.

A steel strip protects the rubber shock absorbers from contact with the ground and a padding of leather is interposed between the axle and the bottom of the Vee. The upward travel of the wheel is limited by a short loop of cable, against which the axle comes to rest after traveling the permissible amount.

(To be continued.)

Book Review

AIRCRAFT MECHANICS HANDBOOK. By Fred H. Colvin, A.S.M.E., McGraw-Hill Book Co., Inc., 239 West 39th Street, New York. ($3.00. 402 pp., fully illustrated.)

This handbook was compiled, as its title indicates, for the air mechanic, and as such it may truly be said to fill a long felt want. Though no originality is claimed by the author for this work, he has nevertheless produced a book that should possess lasting value because of the thorough and practical manner in which the subject of aero-engines is treated.

While the greater part of the handbook deals with the constructional features of the principal types of aero-engines, their care and upkeep, location and remedy of trouble, and with the assembly, adjustment, and general care of the airplane, there are a number of chapters, well worth reading, which furnish information on subjects closely related to the air mechanic's duties, namely, the theory of the airplane, the materials used in its construction, airplane standards of the S.A.E., the Lewis gun, etc.

A chapter dealing with the Canadian Flying School at Camp Borden gives practical examples of the training of British military aviators and the general organization of a modern aerodrome.

Very detailed descriptions, well supplemented with illustrations and diagrams, are given of the Curtiss, Hall-Scott, Sturtevant, Thomas-Morse, Gnome, and Hispano-Suiza engines.

KING GEORGE CLIMBING ON BOARD OF A HANDLEY-PAGE BIPLANE DURING A VISIT OF INSPECTION OF A ROYAL AIR FORCE AERODROME

Photo Press Illustrating Service

The Internal Combustion Turbine*

The advantages that would be derived from the development of the internal-combustion turbine for aircraft work can be appreciated from the fact that a purely rotary motion would then be available for these machines, and all reciprocating parts with their consequent vibration be eliminated. Many authorities consider that the next progress step will undoubtedly be on these lines, and it is generally considered that the practical limit of improvement in the thermal efficiencies of the present engines has now been reached. There is no doubt that in aero-engine design the stage has now been attained where no appreciable progress is to be expected with the existing types of engines, although minor improvements will naturally continue to be made, so further advancement with the motive power will become necessary to obtain better performances from aircraft.

The attractive possibilities of the gas turbine makes the development of this problem well worth investigating, and an account of the work done up to the present may perhaps be of interest. There is every reason to believe that the problem of designing a successful internal-combustion turbine is capable of a comparatively easy solution, and immense advantages will be obtained when this engine is a practical proposition. The turbine which was designed by M. René Armengaud was built in two sizes, one of which was constructed to have an output of 30 hp., and the other was expected to develop ten times this power.

Armengaud Principle

The 300-hp. Armengaud turbine developed practically the power for which it was designed, and both sizes of engines worked on the constant-pressure principle, the combustion of the mixture taking place continuously on its entrance into the combustion chamber. The fuel used during the tests was petrol, and electrical ignition was employed on these machines. Owing to the high temperature of the gases during combustion, the chamber was divided into two portions, the first being lined with carborundum, and the second was jacketed with a coil through which water flowed continuously. This has the effect of cooling the gases, and the water was admitted to the turbine in front of the nozzle when it was vaporized by the ignited gases and had a further cooling effect.

In these turbines the actual medium producing power therefore became a mixture of steam and gas, so that power was generated by this steam on a somewhat similar principle to that adopted in semi-Diesel engines using water injection. In this, as in all other gas turbines, the air had to be compressed in an external air-compressor before being admitted to the combustion chamber, which is one of the inherent defects of the principle of the internal-combustion turbine, especially if a reciprocating compressor be employed. With the 300-hp. Armengaud machine a compressor of the rotary type was adopted, coupled direct to the gas turbine, and the arrangement was fairly satisfactory, the air entering the combustion chamber at a pressure of about 100 lb.

Fuel

The Armengaud design of internal-combustion turbine could doubtless have been developed to employ heavy fuel oil, and although the results obtained from the engines apparently gave great promise, no work seems to have been recently carried out in improving or modifying this design. It is uncertain exactly what degree of economy was obtained with the turbine, but it is understood that the consumption was not reduced to nearly that of the present designs of reciprocating engines, which develop a horse-power with a heat expenditure of less than 10,000 British thermal units.

The Karovodine turbine was of the explosion type, and the method adopted showed great variation from the above design. A series of explosion chambers divided into two portions was employed, one portion of each chamber being vertically above the other, the lower being water-cooled and acting as a mixing chamber. The ignition plug was located in the upper part, and this portion was provided with an outlet for the exploded gases into the nozzle, and thence to the turbine blades. A mixture of air and gasoline passed from the bottom of the combustion chamber through a flap valve into the upper part, and this valve was held upon its seat by means of a spring, so that it could only be opened by pressure from beaneath or suction above. After admission of the air and gasoline through the valve the mixture was exploded in the upper part of the combustion chamber, and from this the gases passed into the nozzle.

Combustion occurred in the top portions of the chamber, and after admission of the gases into the turbine there was a partial vacuum in these, the pressure being about 2 lb. below that of the atmosphere, and this was sufficient to cause the flap valve between the lower and upper parts of each chamber to open, so that air and gasoline were once more admitted into the combustion chamber. The charge was again ignited, and the cycle was continually repeated to obtain uniform rotation of the turbine. The results obtained from this machine were apparently quite good, but unfortunately they have not been followed up, and practically no commercial experience was obtained with the design.

The most important step in the direction of the development of a commercial internal-combustion turbine has been made by Mr. Hans Holzwarth, who has now built a machine with a designed output of 1,000 hp., and has made numerous tests upon it. This turbine embodies a totally different principle from those on which the two previous types were designed, although it is also an explosion turbine, and it may be mentioned that previous to constructing this large machine a small experimental one was built in 1908. The tests carried out on this engine were most instructive, and it was from the results of these tests that modifications were made in the larger machine, upon which a considerable number of important trials have been carried out by the inventor, which were most successful.

Holzwarth Turbine

The Holzwarth turbine has in many ways the most logical principle of operation which has yet been developed in any internal-combustion turbine, and the designer states that the following conditions are essential for a practicable machine: (1) Operation with periodical combustion, *i.e.*, the explosion type must be used as with reciprocating engines. (2) The space in which combustions takes place must be closed on the exhaust side leading to the actual turbine, at least during the greater portion of the charging with the combustible mixture. (3) The combustion chamber must be closed on the admission or charging side during the combustion and expansion period. (4) The combustion chamber must be scavenged with air during the interval between the individual explosions.

It is equally satisfactory for the closing arrangements to be on the exhaust or delivery side on a turbine complying with the above conditions and provided with a combustion chamber, or for the admission or charging side to be provided with mechanically operated valves which serve to deliver air into the combustion chamber. The Holzwarth turbines were of the vertical design, with the shaft arranged vertically, but the construction is equally applicable to machines of the ordinary design with horizontal shafts.

A series of combustion chambers are provided around the periphery of the machines, the number of these in the 1000-hp. turbine being ten, and they are arranged so that the explosion takes place in one combustion chamber after another around the whole circle. The oil fuel or gas is admitted to the combustion chamber, which at the time of the admission is full of air at a comparatively low pressure, it having been previously pumped into the combustion chamber and thence through the turbine at the end of the previous explosion in order to scavenge out and cool the machine thoroughly. After the admission of the gas the inlet valves are closed, and explosion is caused by means of an electric spark; a valve leading to the turbine nozzle is then forced open by the pressure, and the gases pass through to act on the vanes of the machine.

The gases acquire velocity in their passage through the nozzles, and then impinge on the vanes, which are of the ordinary impulse type with two rows of moving blades and one row of fixed blades. The nozzle valve is opened by the pressure due to the explosion, but is afterwards closed gradually by mechanical means, and during the period of closing more scavenging air enters the turbine under slight pressure, so as to clear out the products of combustion from the machine, leaving it full of fresh air ready for the admission of petrol

* Courtesy of *Flying* (London.)

or other fuel into the combustion chamber for another explosion.

Cooling

The air admitted to the machine also has the effect of maintaining the temperature at a reasonably low limit, and no water cooling was necessary, as no excessive heating of the blades was found to occur. The blades were constructed of nickel-steel, and as water was not formed during the process of combustion, no corrosion occurred throughout the long period through which the turbine was tested, also the blades gave no trouble. It was difficult to obtain the anticipated power out of the machine, and the consumption was not so satisfactory as had been anticipated; but many fuels were successfully employed, and it is interesting to note that heavy oil was utilized with success, a pulverizer of the Diesel type being adopted.

The experiments demonstrated that a high specific power could not be obtained from the combustion chambers when the number was relatively small, and that the efficiency of these chambers is lower when they are small than when of moderate size. This tends to indicate the difficulty of constructing a relatively low-powered gas turbine and the suitability of this type of engine for the largest outputs. It is, of course, apparent that there are no maximum limits of power with a turbine, as in a reciprocating engine, where the pressures on the piston cannot be allowed to reach a high figure. It was found that the design of the nozzles for gas could not be based on that of the ordinary steam turbine nozzles, and that the air-scavenging process between two explosions was necessary for reasonable efficiency with this cycle.

The scientific aspect of the design of the Holzwarth turbine is of great importance, and data of considerable value has been deduced from the results of the experiments on his machines. The temperature of the mixture before ignition has an important influence upon the efficiency of a gas turbine, and this should be approximately the same as that of the outside air; also many other important points in connection with the design of internal-combustion turbines were decided from the results of these experiments. No attempts was made to obtain an extremely light weight per horsepower, such as is necessary for aircraft work, as up to the present the experimenters have confined their attention to machines for industrial work.

An internal-combustion turbine proposed by Inrig which makes use of the steam both for purposes of scavenging and keeping the temperatures of the internal parts within reasonable limits has been built, and is intended mainly to employ heavy oils. This is of the horizontal design with an output of 30 hp., and the ordinary reaction blading with several rows of blades is employed. The machine is of the double flow type, and the admission takes place in the centre through one port, there being three valves, one each for air, oil, and water injection. The valves are of the piston type, and are operated by eccentrics mounted on a lay shaft driven from the main shaft through gearing.

The air compressor has to supply air at a high pressure in order to give a sufficiently high temperature to ensure combustion of the heavy fuel which is injected into the turbine immediately after the air. Directly the combustion commences, water is sprayed in, and, owing to the heat generated by the combustion of the fuel, is converted into steam. The ignited gas and steam then passes through nozzles on to the vanes of the turbine, in which they expand down to atmospheric pressure, and their energy becomes converted into work. There is no doubt that the problem of designing a commercially successful internal-combustion turbine will eventually be solved, and there appears to be no reason to anticipate that this type of engine cannot be applied successfully to aircraft.

AMERICAN NAVAL FLYING BOAT BEING SET OFF SHORE IN FRANCE—THIS MACHINE, WHICH IS EVIDENTLY OF FRENCH DESIGN, IS INTERESTING ON ACCOUNT OF ITS PECULIAR TRUSS AND ALSO BECAUSE OF THE CONSTRUCTION OF THE STERN

(C) *Kadel and Herbert*

THREE-QUARTER FRONT VIEW OF THE STURTEVANT SCOUT

An American Pioneer Design

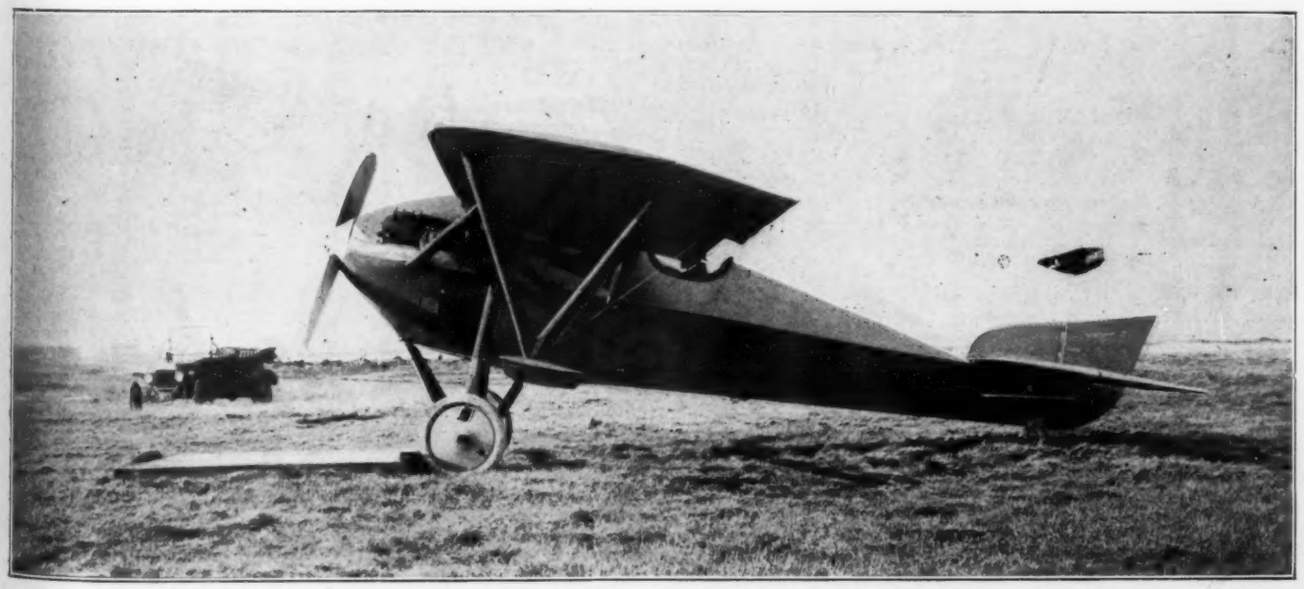
The contention is often made that the manifold difficulties attendant upon the creation of an American air fleet have to some extent been due to the lack of original thought in American airplane design. While this opinion was perhaps justified in some cases, it should nevertheless be considered that before this country entered the great war, there was no incentive, because of small Army and Navy appropriations and lack of sporting interest, to develop original types of machines.

That some American airplane designers were not, however, hopelessly outclassed in their ideas by foreign developments may be seen from the accompanying illustrations which represent a single seater scout designed and built in 1916 by Grover C. Loening, then chief engineer of the Sturtevant Aeroplane Co. of Boston, Mass., for the latter concern.

This machine was the outgrowth of a design originally developed in 1914 by Mr. Loening and Lieut. (now Col.) T. deW. Milling, U. S. A., at the Army flying school at San Diego, Cal. As may be seen, the machine embodied a number of features which are now currently found on the latest machines of the fighting type, but which were distinctly ahead of their time. One may thus note the pyramid truss, the "half-wing" feature created by the streamlining of the single lower spars, the careful cowling of the stationary engine and the use of overhead radiators set into the wings, both of which became recognized German features but a year later.

Particular attention was also paid in the design toward affording a wide range of view and facilities for the mounting of a machine gun, while the compactness of the general layout was quite notable. It should be noted that all structural parts of this machine were built of vanadium steel.

This machine was fitted with a 150 hp. Sturtevant engine of the 8-cylinder, water-cooled type and weighed, net, 1,000 lb. During 1916 it was frequently flown by Lieut. Milling and Bert Acosta, but the restricted nature of Squantum Field, where the trials took place, were such as to cause several crashes on landing. It was little realized at the time how typical these experiences were of what has been found in Europe in the development of new machines.



SIDE VIEW OF THE STURTEVANT SCOUT

International Aircraft Standards

(Continued from previous issues)

2V1—Specifications for Airplane Spar Varnish

GENERAL.—1. The general specifications 1G1 shall form, according to their applicability, a part of these specifications.

COMPOSITION AND GENERAL PROPERTIES.—2. The material shall be the best long oil varnish, suitable for application on wood, "doped" linen or cotton, and metal, and must be resistant to air, light, water, and to washing with warm soap water. The manufacturer is given the greatest latitude in the selection of raw materials and in the process of manufacture in order to produce a product of the highest quality.

PHYSICAL PROPERTIES AND TESTS.—3. The material shall comply with the following requirements:

(*a*) It shall be clear and transparent.

(*b*) Its color shall not be darker than a standard color solution, made by dissolving 6 grams of pure powdered potassium bichromate in 100 cubic centimeters of pure concentrated sulphuric acid (specific gravity 1.84). Gentle heat may be used, if necessary, to secure a perfect solution of the bichromate. The color comparison will be made by placing the varnish and the standard color solution in clear, thin-walled glass tubes of the same diameter, 1.5 to 2 centimeters (⅝ to ¾ in.), to a depth of at least 2.5 centimeters (1 in.), and comparing the colors by looking through the tubes across the column of the liquid by transmitted light.

(*c*) It shall be below 35 deg. C. (95 deg. F.) in an open tester.

(*d*) The varnish shall be flowed on one side of a 10 by 15 centimeter (approximately 4 by 6 in.) panel of bright tin. The panels shall be approximately 0.3 to 0.4 millimeters (0.0125 to 0.0158 in.) thick (90 to 100 lb. weight of base metal per standard box of 112 sheets, 14 by 20 in., No. 30 to No. 28 U. S. standard plate gauge), and shall be cleaned thoroughly with benzol. When the panel is held in a vertical position and maintained at a temperature of 21 to 32 deg. C. (70 to 90 deg. F.), the varnish shall be set to touch at a point not less than 2.5 centimeters (1 in.) from the side of top edges of the film, in not more than 5 hr.; and shall dry hard in not more than 24 hr. to a clear, hard, glossy film. The panel shall then be allowed to dry for a further period of not less than 5 days and then be brought to a temperature of not less than 21 deg. C. (70 deg. F.) nor more than 24 deg. C. (75 deg. F.), and maintained at this temperature for not less than 15 min. The panel, with the varnished side on the outside, shall then rapidly be bent double over a rod 3 millimeters (⅛ in.) in diameter. The varnish film shall show no cracking or flaking at the point of bending.

(*e*) The varnish shall be applied to a basswood panel which has been filled with one coat of drop black in oil thinned with turpentine and drier, and allowed to dry for not less than 10 days before applying the varnish. It shall have suitable body to give proper brushing, flowing, and covering properties. The first coat of varnish shall be allowed to dry 48 hr., then lightly sandpapered, a second coat applied and allowed to dry 72 hr. The panel shall then be inclined at an angle of about 45 deg., and a gentle stream of cold tap water allowed to flow down the middle of the panel for 18 hr. After wiping off any deposits due to the tap water with a chamois skin, the varnish shall show no whitening, dulling, or other defects. A small stream of boiling distilled water shall then be allowed to flow down another portion of the panel for 20 min. The water shall be siphoned through a small glass tube, directly from a container in which it is boiling, onto the surface of the panel, in such a manner that there will be no appreciable lowering of the temperature of the water before it touches the varnish film. The siphon delivery tube shall be in a plane nearly parallel to the plane of the panel, so that the impact of the water will not tend to break the film. The varnish shall show no appreciable whitening and no more than a very slight dulling or other indications of marked deterioration, either when observed immediately after removing from the water or after drying for 2 hr.

[NOTE.—In general, results comparable to those given by the above method may be obtained by flowing one coat of varnish on duplicate panels of bright tin, thoroughly cleaned with benzol, allowing to dry 48 hours, and then immersing one of the panels in distilled water at room temperature for 18 hours and the other panel in boiling distilled water for 15 minutes. But the test on wood should be made in all cases when there is any doubt regarding the resistance of the varnish to water.]

(*f*) The varnish shall be applied in three coats to two unfilled panels of maple wood not less than 14 by 45 by 2 centimeters (5½ by 18 by ¾ in.), allowing 3 days for the drying of each coat. The first coat, after drying indoors for 3 days, shall be sandpapered lightly with No. 00 sandpaper before the application of the next coat. The second and third coats shall not be sandpapered or rubbed, and the duplicate panels shall be exposed outdoors, 45 deg. to the vertical, facing south, 3 days after the application of the finishing coat. The backs and edges of the panels shall also be varnished with three coats of the same sample, but for these surfaces the details of the method of application as given need not be adhered to, and the effects of exposure on these surfaces will not be considered. In the test, the varnish shall show satisfactory durability and weather-resisting properties. In cases when the award of a contract cannot be delayed for the results of the exposure test, award may be made on the basis of the other requirements, but a varnish of any specific brand which does not prove satisfactory in the exposure test may be omitted from consideration in future awards, and a preliminary submission of samples for making exposure tests may be called for.

2F1—Specifications for Mercerized Cotton Airplane Fabric (Grade A)

GENERAL.—1. The general specifications 1G1 shall form, according to their applicability, a part of these specifications.

MATERIAL.—2. (*a*) The warp and filling yarns used in the manufacture of this fabric must be size 2/60, according to the English cotton yarn numbers. A tolerance or plus or minus four (±4) will be allowed in the size of single yarns.

(*b*) The length of the staple of the fabric must not be less than 1½ in.

MANUFACTURE.—3. (*a*) The yarn shall be combed (single or double) and shall be mercerized under tension.

(*b*) It is recommended that the single yarn be given 28 to 34 turns per inch of twist and that 16 turns per inch be used for twisting these yarns together. This procedure may be altered provided that the fabric conforms to this specification in other respects.

(*c*) There must be at least 80 threads and not more than 84 threads per inch in both warp and filling.

(*d*) The weave shall be plain weave.

(*e*) The fabric must be uniform in structure and free from manufacturing imperfections.

(*f*) The fabric, under normal moisture conditions, must not weigh more than 4.5 oz. per sq. yd.

(*g*) The width must be 36 in.

PHYSICAL PROPERTIES AND TESTS.—4.—*Tensile Test.*—(*a*) The tensile test specimens, prepared in accordance with paragraphs 5(*a*), 5(*b*), 5(*c*), shall be exposed for at least two hours in an atmosphere of (5 per cent relative humidity at 70 deg. F. (21 deg. C.) and then tested in this atmosphere.

(*b*) The distance between the jaws or clamps of the testing machine at the beginning of the test shall be 8 in. (20 cm.). The pulling jaw shall move at the rate of 12 in. per min. during the test.

(*c*) The average breaking load of the five specimens cut in the direction of the warp and the average breaking load of the five specimens cut in the direction of the filling, as shown in Fig. 1, must each be at least 80 lb.

(*d*) The elongation shall be observed when the specimens are subjected to each of the loads given in Table 1.

(*e*) Whenever practicable, an autographic record shall be taken.

(*f*) The elongation must not exceed the values given in Table 1 by more than 10 per cent.

(*g*) The average results for both warp and filling shall be reported separately.

TABLE 1

Tension in Pounds.	Elongation in Inches, Warp.	Elongation in Inches, Filling.
10	0.65	0.32
20	.80	.40
70	1.20	.64

Test for Sizing.—(*h*) Tests for sizing shall be conducted as follows:

(1) Dry samples weighing approximately 0.18 ounce (5 gm.) in tared weighing bottles at 221 to 230 deg. F. (105 to 110 deg. C.) to constant weight.

(2) Boil the samples in water for 10 minutes and rinse thoroughly.

(3) Digest each sample in a solution containing 15 centimeters commercial diastofor in 500 centimeters water at 140 deg. F. (60 deg. C.) for two hours.

(4) Wash thoroughly in hot water and then boil for one hour in 500 centimeters distilled water and wash again.

(5) Dry in tared weighing bottles to constant weight.

(6) Percentage sizing = $\frac{\text{loss in weight}}{\text{original weight}} \times 100.$

(*i*) The fabric must not contain more than 3.5 per cent of sizing, as determined by the above method.

Mercerization Test.—(*j*) Take approximately one-fourth square foot of the cloth, immerse in boiling distilled water and stir occasionally while cooling. At the end of 10 minutes place a strip of blue and a strip of red litmus paper into the liquid with the fabric and allow them to remain 5 minutes. At the end of this time the litmus papers must have retained their original colors. Any cloth showing either an acid or alkaline reaction shall be rejected. This test may be made on the yarn before weaving by substituting a small handful of the yarn for the cloth sample.

SELECTION OF TEST SPECIMENS.—5. (*a*) Samples for tests shall be taken from at least five bolts in each warp woven.

(*b*) The sample taken from a bolt shall be 1 yard long and the full width of the bolt; it shall be cut from the fabric at a point 10 yards from the end of the bolt.

(*c*) Test specimens for tensile tests, 12 inches long and 1¼ inches wide, shall be cut from each sample taken as shown in Fig. 1. Threads shall be pulled out from the sides of the test specimens until a width of 1 inch of woven fabric remains.

INSPECTION AND REJECTION.—6. The inspector shall mark all accepted material close to the end of each bolt with the official acceptance stamp. Rejected material shall be marked with the rejection stamp and shall not be resubmitted without the express consent of the purchaser. The acceptance and rejection stamps shall be so placed that they do not injure the material, or, in the case of rejected fabric, so that the marking does not preclude the use of the material for other than aircraft work.

REPLACEMENTS.—7. All fabric that does not conform to this specification shall be rejected and shall be replaced by the manufacturer at his expense.

2F2.—Specifications for Unmercerized Cotton Airplane Fabric (Grade A)

GENERAL.—1. The general specifications 1G1 shall form, according to their applicability, a part of these specifications.

MATERIAL.—2. (*a*) The warp and filling yarns used in the manufacture of this fabric must be size 2/60, according to the English cotton-yarn numbers. A tolerance of plus or minus four (±4) will be allowed in the size of single yarns.

(*b*) The length of the staple of the fabric must not be less than 1½ inches.

MANUFACTURE.—3. (*a*) The yarn shall be combed (single or double).

(*b*) It is recommended that the single yarn be given 22 to 25 turns per inch of twist and that 25 to 26 turns per inch be used for twisting this yarn together. This procedure may be altered provided that the fabric conforms to this specification in other respects.

(*c*) There must be at least 93 threads per inch in warp and 86 threads per inch in filling. A tolerance of plus or minus two (±2) threads will be allowed.

(*d*) The weave shall be a plain weave.

(*e*) The fabric must be uniform in structure and free from manufacturing imperfections.

(*f*) The fabric, under normal moisture conditions, must not weigh more than 4.5 ounces per square yard.

(*g*) The width must be 36 inches.

PHYSICAL PROJERTIES AND TESTS.—4. *Tensile Test.*—(*a*) The tensile test specimens, prepared in accordance with paragraphs 5 (*a*), 5 (*b*), and 5 (*c*), shall be exposed at least two hours in an atmosphere of 65 per cent relative humidity at 70 deg. F (21 deg. C.) and then tested in this atmosphere.

(*b*) The distance between the jaws or clamps of the testing machine at the beginning of the test shall be 8 inches (20 cm.). The pulling jaw shall move at the rate of 12 inches (30 cm.) per minute during the test.

(*c*) The average breaking load of the five specimens cut in the direction of the warp and the average breaking load of the five specimens cut in the direction of the filling, as shown in Fig. 1, must each be at least 75 pounds.

(*d*) The elongation shall be observed when the specimens are subjected to each of the loads given in Table 1.

(*e*) Whenever practicable an autographic record shall be taken.

(*f*) The elongation must not exceed the values given in Table 1 by more than 10 per cent.

(*g*) The average results for both warp and filling shall be reported separately.

TABLE 1

Tension in Pounds.	Elongation in Inches, Warp.	Elongation in Inches, Filling.
10	0.74	0.42
20	.94	.53
70	1.44	.90

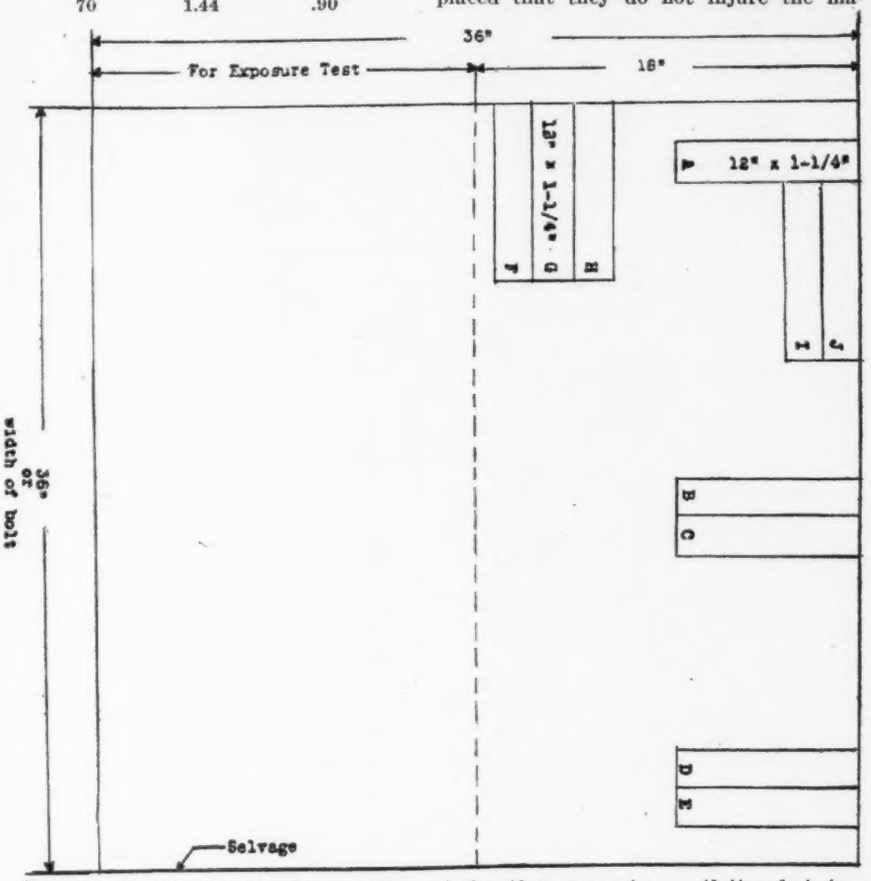


FIG. 1.—*Sketch showing the location of the 10 test specimens (lettered A to F) to be cut from the sample.*

Test for Sizing.—(*h*) Tests for sizing shall be conducted as follows:

(1) Dry samples weighing approximately 0.17 ounce (5 gm.) in tared weighing bottles at 221 to 230 deg. F. (105 to 110 deg. C.) to constant weight.

(2) Boil the samples in water for 10 minutes and rinse thoroughly.

(3) Digest each sample in a solution containing 15 cubic centimeters commercial disatofor in 500 cubic centimeters water at 140 deg. F. (60 deg. C.) for two hours.

(4) Wash thoroughly in hot water and then boil for one hour in 500 cubic centimeters distilled water and wash again.

(5) Dry in tared weighing bottles to constant weight.

(6) Percentage sizing = $\frac{\text{loss in weight}}{\text{original weight}} \times 100$.

(*i*) The fabric must not contain more than 3.5 per cent of sizing, as determined by the above method.

SELECTION OF TEST SPECIMENS.—5. (*a*) Samples for tests shall be taken from at least five bolts in each warp woven.

(*b*) The sample taken from a bolt shall be 1 yard long and the full width of the bolt; it shall be cut from the fabric at a point 10 yards from the end of the bolt.

(*c*) Test specimens for tensile tests, 12 inches long and 1¼ inches wide, shall be cut from each sample taken as shown in Fig 1. Threads shall be pulled out from the sides of the test specimens until a width of 1 inch of woven fabric remains.

INSPECTION AND REJECTION.—6. The inspector shall mark all accepted material close to the end of each bolt with the official acceptance stamp. Rejected material shall be marked with the rejection stamp and shall not be resubmitted without the express consent of the purchaser. The acceptance and rejection stamps shall be so placed that they do not injure the material, or, in the case of rejected fabric, so that the marking does not preclude the use of the material for other than aircraft work.

REPLACEMENTS.—7. All fabric that does not conform to this specification shall be rejected and shall be replaced by the manufacturer at his expense.

2F3.—Specifications for Mercerized Cotton Airplane Fabric (Grade B)

GENERAL.—1. (*a*) The general specifications 1G1 shall form, according to their applicability, a part of these specifications.

MATERIAL.—2. The warp and filling yarns used in the manufacture of this fabric must be size 3/80, according to the English cotton yarn numbers. A tolerance of plus or minus four (±4) will be allowed in the size of single yarns.

(*b*) The length of the staple of the fabric must not be less than 1½ inches.

MANUFACTURE.—3. (*a*) The yarn shall be combed (single or double) and shall be mercerized under tension.

(*b*) It is recommended that the single yarn be given 36 to 40 turns per inch of twist and that 18 to 20 turns per inch be used for twisting these yarns together. This procedure may be altered, provided that the fabric conforms to this specification in other respects.

(*c*) There must be at least 68 threads and not more than 72 threads per inch in both warp and filling.

(*d*) The weave shall be a plain weave.

(*e*) The fabric must be uniform in structure and free from manufacturing imperfections.

(*f*) The fabric, under normal moisture conditions, must not weigh more than 4 ounces per square yard.

(*g*) The width must be 36 inches.

PHYSICAL PROPERTIES AND TESTS.—4.—*Tensile Test.*—(*a*) The tensile-test specimens, prepared in accordance with paragraphs 5 (*a*), 5 (*b*), and 5 (*c*), shall be exposed for at least two hours in an atmosphere of 65 per cent relative humidity at 70 deg. F. (21 deg. C.) and then tested in this atmosphere.

(*b*) The distance between the jaws or clamps of the testing machine at the beginning of the test shall be 8 inches (20 cm.). The pulling jaw shall move at the rate of 12 inches per minute during the test.

(*c*) The average breaking load of the five specimens, cut in the direction of the warp and the average breaking load of the five specimens cut in the direction of the filling, as shown in Fig. 1, must each be at least 73 pounds.

(d) The elongation shall be observed when the specimens are subjected to each of the loads given in Table 1.

(*e*) Whenever practicable an autographic record shall be taken.

(*f*) The elongation must not exceed the values given in Table 1 by more than 10 per cent.

(*g*) The average results for both warp and filling shall be reported separately.

TABLE 1

Tension in Pounds.	Elongation in Inches, Warp.	Elongation in Inches, Filling.
10	0.70	.044
20	.86	.52
65	1.19	.78

Test for Sizing.—(*h*) Tests for sizing shall be conducted as follows:

(1) Dry samples weighing approximately 0.18 ounce (5 gm.) is tared weighing bottles at 221 to 230 deg. F. (105 to 110 deg. C.) to constant weight.

(2) Boil the samples in water for 10 minutes and rinse thoroughly.

(3) Digest each sample in a solution containing 15 cubic centimeters commercial diastofor in 500 cubic centimeters water at 140 deg. F. (60 deg. C.) for two hours.

(4) Wash thoroughly in hot water and then boil for one hour in 500 cubic centimeters distilled water and wash again.

(5) Dry in tared weighing bottles to constant weight.

(6) Percentage sizing = $\frac{\text{loss in weight}}{\text{original weight}} \times 100$.

(i) The fabric must not contain more than 3.5 per cent of sizing, as determined by the above method.

Mercerization Test.—(*j*) Take approximately one-fourth square foot of the cloth, immerse in boiling distilled water, and stir occasionally while cooling. At the end of ten minutes place a strip of blue and a strip of red litmus paper into the liquid with the fabric and allow them to remain 5 minutes. At the end of this time the litmus papers must have retained their original colors. Any cloth showing either an acid or alkaline reaction shall be rejected. This test may be made on the yarn before weaving by substituting a small handful of the yarn for the cloth sample.

SELECTION OF TEST SPECIMENS.—5. (*a*) Samples for tests shall be taken from at least five bolts in each warp woven.

(*b*) The sample taken from a bolt shall be 1 yard long and the full width of the bolt; it shall be cut from the fabric at a point 10 yards from the end of the bolt.

(*c*) Test specimens for tensile tests, 12 inches long and 1¼ inches wide, shall be cut from each sample taken, as shown in Fig. 1. Threads shall be pulled out from the sides of the test specimens until a width of 1 inch of woven fabric remains.

INSPECTION AND REJECTION.—6. The inspector shall mark all accepted material close to the end of each bolt, with the official acceptance stamp. Rejected material shall be marked with the rejection stamp and shall not be resubmitted without the specific consent of the purchaser. The acceptance and rejection stamps shall be placed so that they do not injure the material, or, in the case of rejected fabric, so that the marking does not preclude the use of the material for other than air craft work.

REPLACEMENTS.—7. All fabric that does not conform to this specification shall be rejected and shall be replaced by the manufacturer at his expense.

2F4.—Specifications for Unmercerized Cotton Airplane Fabric (Grade B)

GENERAL.—1. The general specification 1G1 shall form, according to their applicability, a part of these specifications.

MATERIAL.—2. (*a*) The warp and filling yarns used in the manufacture of this fabric must be size 3/80, according to the English cotton yarn numbers. A tolerance of plus or minus four (±4) will be allowed in the size of single yarns.

(*b*) The length of the staple of the fabric must not be less than 1½ inches.

MANUFACTURE.—3. (*a*) The yarn shall be combed (single or double).

(*b*) It is recommended that the single yarn be given 36 to 40 turns per inch of twist and that 18 to 20 turns per inch be used for twisting these yarns together. This procedure may be altered provided that the fabric conforms to this specification in other respects.

(*c*) There must be at least 68 threads and not more than 72 threads per inch in both warp and filling.

(*d*) The weave shall be a plain weave.

(*e*) The fabric must be uniform in structure and free from manufacturing imperfections.

(*f*) The fabric, under normal moisture conditions, must not weigh more than 4.2 ounces per square yard.

(*g*) The width must be 36 inches.

PHYSICAL PROPERTIES AND TESTS.—4.—*Tensile test.*—(*a*) The tensile test specimens, prepared in accordance with paragraphs 5(*a*), 5(*b*), and 5(*c*), shall be exposed for at least two hours in an atmosphere of 65 per cent relative humidity at 70 deg. F. (21 deg. C.) and then tested in this atmosphere.

(*b*) The distance between the jaws or clamps of the testing machine, at the beginning of the test, shall be 8 inches (20 cm.). The pulling jaw shall move at the rate of 12 inches per minute during the test.

(*c*) The average breaking load of the five specimens, cut in the direction of the warp and the average breaking load of the five specimens cut in the direction of the filling, as shown in Fig. 1, must each be at least 70 pounds.

(*d*) The elongation shall be observed when the specimens are subjected to each of the loads given in Table 1.

(*e*) Whenever practicable an autographic record shall be taken.

(*f*) The elongation must not exceed the values given in Table 1 by more than 10 per cent.

(*g*) The average results for both warp and filling shall be reported separately.

TABLE 1

Tension in Pounds.	Elongation in Inches, Warp.	Elongation in Inches, Filling.
10	0.84	0.68
20	1.06	.84
65	1.53	1.24

Test for Sizing.—(*h*) Tests for sizing shall be conducted as follows:

(1) Dry samples weighing approximately 0.18 ounce (5 gm.) in tared weighing bottles at 221 to 230 deg. F. (105 to 110 deg. C.) to constant weight.

(2) Boil the samples in water for 10 minutes and rinse thoroughly.

(3) Digest each sample in a solution containing 15 cubic centimeters commercial diastofor in 500 cubic centimeters water at 140 deg. F. (60 deg. C.) for two hours.

(4) Wash thoroughly in hot water and then boil for one hour in 500 cubic centimeters distilled water and wash again.

(5) Dry in tared weighing bottles to constant weight.

(6) Percentage sizing = $\frac{\text{loss in weight}}{\text{original weight}} \times 100$.

(*i*) The fabric must not contain more than 3.5 per cent of sizing, as determined by the above method.

SELECTION OF TEST SPECIMENS.—5. (*a*) Samples for tests shall be taken from at least five bolts in each warp woven.

(*b*) The sample taken from a bolt shall be 1 yard long and the full width of the bolt; it shall be cut from the fabric at a point 10 yards from the end of the bolt.

(*c*) Test specimens for tensile tests, 12 inches long and 1¼ inches wide, shall be cut from each sample taken as shown in Fig. 1. Threads shall be pulled out from the sides of the test specimens until a width of 1 inch of woven fabric remains.

INSPECTION AND REJECTION.—6. The inspector shall mark all accepted material close to the end of each bolt with the official acceptance stamp. Rejected material shall be marked with the rejection stamp and shall not be resubmitted without the specific consent of the purchaser. The acceptance and rejection stamps shall be placed so that they do not injure the material, or, in the case of rejected fabric, so that the marking does not preclude the use of the material for other than aircraft work.

REPLACEMENTS.—7. All fabric that does not conform to this specification shall be rejected and shall be replaced by the manufacturer at his expense.

Save Walnut for Airplane Propellers

The following letter has been sent to lumber manufacturers:

Office of Chief Signal Officer,
WASHINGTON, D. C., March 28, 1918.

1. The Ordnance Department and the Signal Corps of the United States Army jointly request that you refrain for the duration of the war from the manufacture of veneer from walnut lumber, other than butts, crotches, or figured material, none of which walnut lumber is suitable for the manufacture of gun stocks or airplane propellers.

2. The walnut lumber that enters into the manufacture of veneers, other than that above stated, is urgently needed at this time by the United States Government in the prosecution to a successful conclusion of the war which we are now waging against Germany. In other words, this lumber is a vital necessity for the manufacture of gun stocks and airplane propellers for the immediate equipment of our forces. It is requested, therefore, that you refrain from the manufacture of all veneers, as stated above.

3. Your reply in confirmation of the above request is in order.

By direction of the Acting Chief of Ordnance and the Chief Signal Officer, United States Army.

Procurement Division, Small-Arms Section.

E. A. SHEPARD,
Major, Ordnance Department, N. A.

Digest of the Foreign Aeronautical Press

Aeronautics (London), April 3, 1918

The British Flying Services in 1917—In the War Cabinet Report 1917 the following reference to the expansion and work of the British Flying Services during 1917 is of interest: The Royal Naval Air Service at the outbreak of war possessed a personnel of under 800; at the present moment the numbers approach 46,000 and are continually increasing. Their material after the outbreak of war consisted of seven non-rigid airships, considerably less than 100 efficient seaplanes and airplanes, and no kite balloons. At the present time there are some 176 airships and kite balloons, well over 2,500 seaplanes and airplanes, and a great number of motor boats and subsidiary appliances of all kinds.

The Royal Flying Corps has shown a very remarkable development. The number of units, for instance, formed in the past year was as large as the total number of units which had been formed previously in the whole 2¼ years of war. In the matter of personnel, the number of both officers and other ranks has doubled, the latter being largely drawn from unskilled and partially skilled workers in various metal and engineering trades. The increase in the supply of future flying officers is especially striking. The monthly influx of cadets for training at Cadet Training Wings has increased tenfold, and boys too young for these are admitted to a preparatory training school. Altogether the number of officers passing through the training squadrons as graduated pilots is more than 200 per cent. greater than it was in January, 1917. This growth in number has been achieved in spite of the fact that the length of time occupied in training has increased. The technical and equipment sides of the Corps have shown a similar development, the supply of airplanes having been doubled during the first nine months of this year. The importance of the work done by the Flying Corps in the field as the eyes of our Army, can be only faintly imagined from the official communiqués. These, however, show that in France, during the period mentioned, 876 enemy machines were brought crashing to the ground, and 759 others driven down out of control by our airmen apart from invaluable services rendered in bombing the enemy's bases, locating his batteries, and taking photographs of his lines.

The heavy losses inflicted upon enemy airships in 1916 brought about a temporary lull in Zeppelin raids on this country in the first few months of 1917. On May 25, however, the enemy had recourse to a far more effective though not unforeseen form of aerial attack. On that date eighteen Gotha biplanes crossed the Essex coast in full daylight, and being balked by cloud in their attempt to reach London, circled southward across the Thames and bombed Folkestone and the neighboring camps. Between May 25 and August 22 the enemy made eight daylight raids on this country, two of which were on London. Meanwhile our defenses were being rapidly improved, the number of guns was increased and homogeneous fighting squadrons organized; consequently, the enemy abandoned attempts on London and confined himself to tip and run raids on coast towns. On August 22 two Gotha planes were shot down near Margate and a third off Dover, while two more machines were destroyed on their way back to Belgium after which daylight raids were abandoned. Thus, in four months, our aerial defenses, for the time being, at any rate, mastered this new form of attack. The enemy's losses during the period of the daylight raids may be summarized as follows:

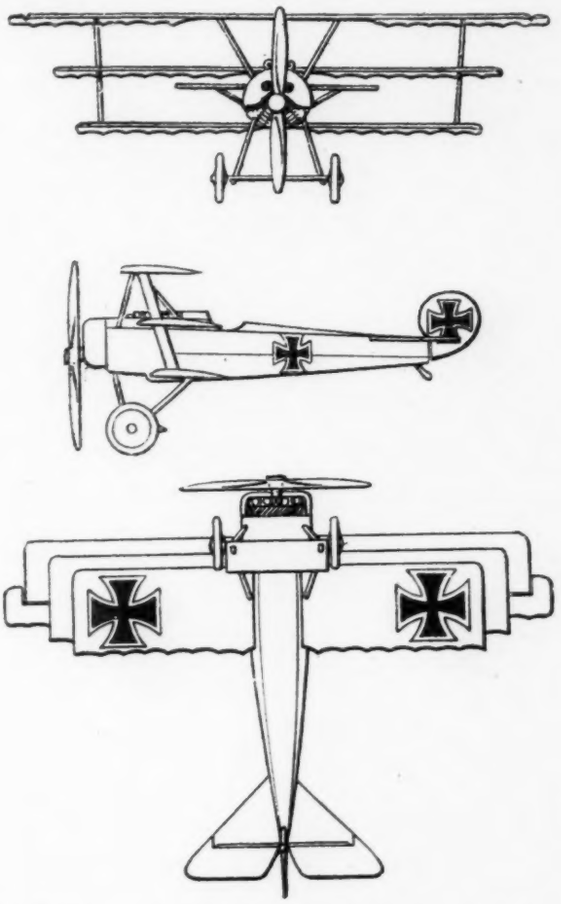
Certain	Almost Certain	Doubtful
9	9	2

This does not include machines which are known to have crashed in Belgium.

On September 2 this same squadron of Gotha airplanes carried out an attack on Dover by moonlight; this was followed on the succeeding night by an attack on Chatham and Sheerness by about eight machines. On the night of September 4-5 twenty-four airplanes crossed the coast, and about one-third of that number attacked London. Between September 2, 1917, and the present time (February 8, 1918) there have been seventeen moonlight airplane raids on England, most of which have been directed against the capital.

L'Aerophile (Paris), March, 1918

The Fokker Triplane.—The Fokker triplane is one of the most recently commissioned one-seater pursuit machines of the German Flying Corps. French observers had for some time noticed this type machine flying at great altitudes and at about 10 km. back of the enemy lines. More recently, however, these triplanes have crossed the lines and one was brought down by the British,, so that dimensions and characteristics are now available. (A general description of this machine was digested from *Flight* in the April 15, 1918, issue of AVIATION AND AERONAUTICAL ENGINEERING.—*Editor.*)



The Fokker triplane cannot be called an original German product, for long before its appearance several French manufacturers, namely, Morane-Saulnier, Nieuport and Spad, experimented with triplanes, and a Sopwith pursuit triplane was used at the front by the Royal Flying Corps. The latter actually served as a model to the Fokker triplane, although the British had stopped using it by the time the Fokker made its appearance.

The chief characteristics and dimensions of the Fokker triplane are the following:

The span is decreasing from the upper to the lower wings. The upper plane has a span of 7 m. and is the only one to carry ailerons. These are balanced by a portion over-lapping outwardly, whereby the overall span is increased to 7.60 m. The intermediate plane, which is carried 0.75 m. below the upper plane, has a span of 6.40 m. and is fitted flush with the top of the body. Both the upper and the intermediate planes are made of one piece.

The lower plane, which is situated at the same distance from the intermediate plane as the upper one, is composed of two wings of 2.50 m. span each. These are fitted to the lower body longitudinals. The chord of all three planes is 1.20 m. The cabane consists of two V-struts sloping outwards. There is only one interplane strut on either side of the body.

The tail planes consist of a horizontal fin, with balanced elevator, and a balanced rudder without vertical fin. Their framework is built up of steel tubing.

The body is similarly built up of steel tubing (which is a characteristic feature of Fokker construction, *Editor*); the

cross-section is hexagonal in the forward portion and tapers to a vertical knife-edge at the rear.

The engine is a 100-110 hp. Oberursel rotary (German copy of the Gnome). The airscrew is an "Axial," and measures 2.60 m. in diameter.

The armament consists of two synchronized Spandau machine guns, which can be fired conjointly or separately. According to German claims, this machine climbs to 4,500 m. in 17 minutes. The late Captain von Richthofen used a Fokker triplane in his "flying circus."

A New German Airplane—A new German two-seater fighter has recently made its appearance on the Western front. One of these machines was brought down by the French, and duly examined. Unfortunately, it was so badly wrecked that its reconstitution does not afford a detailed description, and only its general outlay is therefore known.

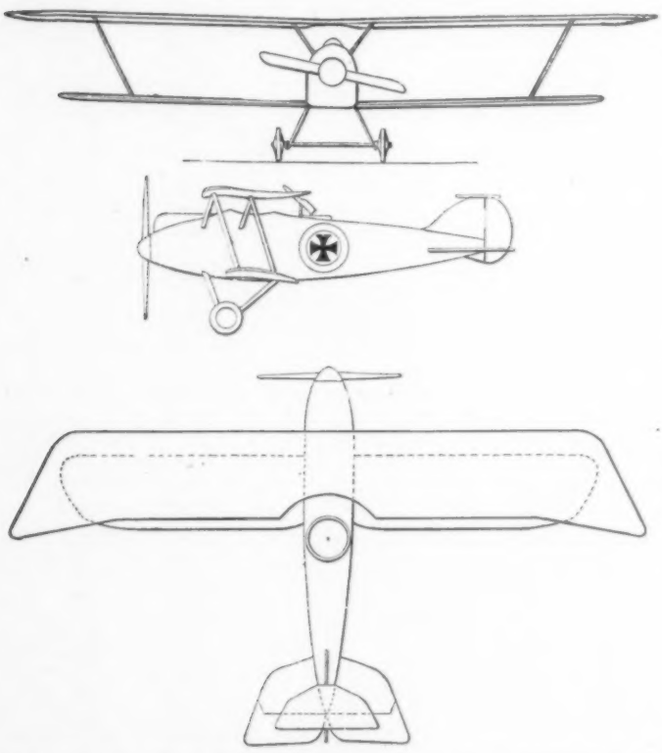
It has not even been possible to ascertain beyond doubt the name of its manufacturer, as this is hidden behind the initials H. W., which is variously believed to indicate Halberstadt, or Hannoveraner Werke.

The most striking features of the H. W. biplane are a very fat, streamlined body, reaching close to the upper plane, and a biplane tail. The latter feature is a distinct innovation in German airplane design.

Another unusual characteristic of the H. W. is the *Taube* wing shape of the upper plane, whereas the lower plane has the well known Bleriot form, that is to say, the tips of the upper plane slope outwards, while those of the lower plane slope inwards.

The planes are staggered about 0.60 m. forward and are set at a slight dihedral, but do not embody any sweep back.

The span of the upper plane is about 11 m.; that of the lower plane is slightly smaller and is believed to be in the neighborhood of 10 m. Opinion varies as to the existence of a center section, as no trace of a cabane has been found in



the wreckage of the H. W. It is, however, quite possible that the upper plane, which is of two pieces, was directly attached to the upper longitudinals of the body, for all French observers are agreed as to the short distance separating the body from the upper plane.

Only the upper plane carries ailerons; these are of the balanced, overlapping type. The planes are connected with one another by a pair of interplane struts, sloping outwards, and situated on either side of the body.

The engine is a 180 hp. stationary Opel.

The tail consists of two semi-circular—or, according to other reports, trapezoidal—planes which are set in biplane fashion one above the other. The upper plane is considerably smaller, as may be seen from the accompanying diagrams, than the lower plane, and appears to act as a stabilizer only, whereas the lower plane carries a balanced elevator. The rudder does not appear to be balanced, but is preceded by a vertical fin.

The armament consists of a synchronized machine gun, forward, and a machine gun mounted on a gun ring, aft. Owing to the great depth of the body it appears that the gunner can, from the after seat, fire over the planes, that is, forward.

A bomb gear for 11.5 kg. bombs is carried by some of these machines, while others are fitted with a camera. This shows that the H. W. biplane belongs to the German C-class, that is, the general utility class of airplanes.

Aeronautics (London), March 27, 1918

Recent Air Raids into Germany—In reply to a question by Mr. Joynson-Hicks as to details of recent British air raids on Germany, Mr. Macpherson, Under-Secretary of State of War, made on March 19, in the House of Commons, the following declaration:

"Since October we have made 38 effective raids into Germany, and we have dropped 48 tons of explosives—a remarkable achievement under the circumstances. The conditions under which these raids have been carried out during the winter have been extremely difficult. In the Lorraine region, throughout the winter, it is only on rare occasions that flying can be successfully carried out.

"Approximately 250 flights have been made in the course of these raids, during which only 10 machines have been lost.

"There has been a steady increase in the number of raids carried out and the amount of explosive dropped, whilst the increased distance to which raids have been carried into Germany is most satisfactory. This is particularly so in the case of the recent raids during March, which have so far been eight in number.

"I would point out that the majority of raids by British machines have been carried out in broad daylight, and photographs have been taken of the bursting bombs, placing the accuracy of the reports received of their effect beyond all shadow of doubt. Further, by attacking in daylight, it has been possible to concentrate attack on objects of actual military importance—a striking contrast to the promiscuous methods adopted by the enemy.

"During the night raids our machines have descended to low heights, and fired at searchlights, trains, and railway stations. A steady increase has been observed in the enemy's anti-aircraft defenses, the number of searchlights, guns, and aeroplanes. These latter have been defeated with loss whenever they have attempted to intervene.

"On other occasions our pilots have attacked enemy machines drawn up on the aerodromes preparatory to making bombing raids into France. The following report on a recent raid is typical of the results obtained:

"Twelve aeroplanes left at 9.35 a. m. to bomb the railway stations, barracks, and Daimler Motor Works at Stuttgart. Eleven of these machines reached the objective. One machine failed to return, being seen to fire a green light on the return journey, and go down under control, apparently with engine trouble, southeast of Oberkirch.

"The following bombs were dropped on the objective with excellent results:

3	230 lb.	
16	112 lb.	
9	40 lb.	(phos.)
Total ..	2,842 lb.	

"Several bursts were seen on the Daimler Motor Works, and several on the railway lines. Mettingen Station was hit and set on fire. A train which was standing in the station was also set on fire. Two bombs burst near the electric power station in the town, one beside the railway sidings, one near the gasworks, and five or six bursts in or around the Gare de Triage. Two bursts were seen by the bridges over the river, and two beside a large munition factory southeast of the town. A total of 36 plates were exposed of Stuttgart, which have come out very well, and which show bombs bursting on objectives.

"Three enemy aircraft attacked our machines over the objective, one being a two-seater and the other two Albatros D 3 type.

"After the first combat the enemy aircraft followed our machines, shooting at long range, and then withdrew."

The Aircraft Situation

Very little as to the plans of the War Department has been made known since the appointment of John D. Ryan as Director of Aircraft and of Gen. William L. Kenly as chief of the Division of Military Aeronautics, Aviation Section, Signal Corps. While plans are under way for reorganization of the Air Service, it is believed that no radical changes will be made until empowering legislation is secured. This legislation may be in the form of a special law, but probably the Overman bill when passed will serve as authority for the changes the President will make. It is thought this bill, which has passed the Senate and been reported to the House without change, will soon become a law. Under it the President will be empowered to make practically any changes he desires without other Congressional sanction.

No accurate forecast of the reorganization plans is possible. It is deemed certain, however, that the Aviation Section will be completely divorced from the Signal Corps. Whether it will remain under the direction of the Secretary of War, or joined with the Naval Flying Corps and administered by a new cabinet officer, is a matter of conjecture—but the impression that the Air Service will become a separate service is growing among those who usually are well informed.

It is understood that General Kenly's idea is to have a new organization to be known as the Air Service, which is the term now used by the American Expeditionary Force. This plan is said to contemplate the creation of three divisions of the Air Service at the head of which will be Mr. Ryan. One of these is the Division of Military Aeronauties, of which General Kenly is the head; a second, the Production Division, of which as head of the present Equipment Division W. C. Potter will be chief, and the third a Technical Division, the scope and the relation of which to the other two divisions, in charge of another man, is to be worked out.

Mr. Potter is very busy with his part in the plans of reorganization in addition to his regular duties. Several of the Departments of the Equipment Division have already been removed to new quarters to make more room for others at 119 D Street, N. E. These include the Lubrication Department, which is now located at 1335 F Street, N. W., and the Motor Transportation and Supply Departments, the Signal Material and Export Sections and the office of Colonel Waldron, which are now at 635 F Street, N. W. It is reported that the office of Mr. Potter may soon be located in the Munsey Building, where the Aircraft Board now is.

At least one notable change has occurred in the personnel of the Equipment Division. Reference is made to the resignation by Maj. Harry L. Shepler of his commission in the Army, and its acceptance by the President to date from April 29 Major Shepler had been in charge of the plane production section. What this signifies is not revealed.

The Aircraft Board

John D. Ryan, the director of Aircraft, is also chairman of the Aircraft Board in place of Howard E. Coffin, resigned. While rumors are current that all of the members of the Board have handed in their resignations, no verification of this can be secured. It is known, however, that Harry B. Thayer, who has been on the Board since March 1, is out. Under the law creating the Board provision is made that the Chief Signal Officer of the Army and the Chief Constructor of the Navy shall be members of the Board. Therefore it would appear that Maj. Gen. G. O. Squier and Rear Admiral D. W. Taylor could not resign should they desire to do so.

Nominations Confirmed

The nomination by the President of "John D. Ryan of Montana to be chairman of the Aircraft Board," and the appointment of "Brig.-Gen. William L. Kenly, National Army, to be major general with rank from April 29, 1918," were received by the Senate on May 3, and have been confirmed.

Investigations

Many views on the aircraft situation have been expressed in the House of Representatives during the past fortnight, and frequent references was made to the report given to the President by Gutzon Borglum, the sculptor.

The demand for an investigation of the allegations of graft was heeded on May 6 by the President who decided to turn the whole matter over to Attorney General Gregory, who was instructed to make a thorough investigation of the "wholesale charges" in regard to the production of aircraft made by Borglum.

The President's decision in favor of an investigation was announced after he had received from Howard E. Coffin, late chairman of the Aircraft Board, who had been South, a telegram urging that an official inquiry be made "in order that the reputations of innocent men may not be ruined."

The announcement of the President's decision was made when the White House gave out copies of messages exchanged between President Wilson and Howard E. Coffin and a copy of a letter sent by President Wilson to Senator Thomas of the Military Affairs Committee, in which the President expressed the hope that "the matter will be treated as one for searching official investigation by the constituted authorities of the Government" and said that "every instrumentality at the disposal of the Department of Justice will be used to investigate and pursue charges of dishonesty or malversation of any kind."

The President also made public seven letters he had sent to Mr. Borglum or Secretary of War Baker in the last five months in connection with the investigation the sculptor was making into the aircraft production situation. These show that the President in January urged Mr. Borglum to come to Washington, lay the whole matter frankly and fully before Secretary Baker, "and by your own investigation discover the facts in this business," but in April wrote him that "I never at any time constituted you an official investigator."

Attorney General Gregory has placed Assistant Attorney General Frierson of the Department of Justice in direct charge of the investigation, and it is said that he immediately began the study of the reports that have been submitted by Gutzon Borglum, the special committee headed by H. Snowden Marshall and the Senate Committee on Military Affairs. While Mr. Frierson has not yet had an opportunity to examine any witnesses, it is thought that he will do so without delay.

The Senate to Investigate

On May 8, Senator Chamberlain, chairman of the Committee on Military Affairs, introduced a resolution calling for an investigation of the aircraft situation by the Committee on Military Affairs or by a sub-committee of that body, authorizing and directing it "to inquire into and report to the Senate the progress of aircraft production in the United States, or any other matter relating to the conduct of the war by or through the War Department."

It is understood that Senator Chamberlain's idea is to make a most thorough investigation of the entire aircraft situation and to examine many witnesses who have first-hand knowledge of conditions.

Court of Inquiry Requested

Another feature was added to the case when it became known that Major-General Squier, Chief Signal Officer; Col. E. A. Deeds and Col. R. L. Montgomery, the Army's representatives on the Aircraft Board, have requested the appointment of a court of inquiry to examine into their conduct. Secretary Baker has announced that he will hold these requests in abeyance, because he believes a third examination of the same set of facts at the same time might confuse, if not delay, the inquiry. Therefore the military court is not likely to be assembled until the other investigations have been concluded.

Borglum's Reported Interests

According to press reports documents from the official files of the government have been made available for the use of the Senate which are alleged to show that Borglum, whose charges against the airplane program constituted one of the direct causes leading up to the airplane inquiries, has been connected with negotiations for the establishment of a new aircraft corporation in which he was to have been a silent partner.

It is stated that interesting correspondence and affidavits will be read into the *Congressional Record*, and that these documents will also be used in questioning the sculptor when he is called before the sub-committee of the Committee on Military Affairs which will conduct the inquiry into the entire aircraft situation.

News of the Fortnight

Army to Examine All Inventions

What will be welcome news to the thousands of inventors, who have endeavored in vain to have their ideas considered by the War and Navy Departments, is that an Inventions Section has been established at the Army War College, Washington, D. C., and that a staff of experts will be in session there daily to consider and pass upon the merits of inventions of a military nature which are of possible value to the Army.

Knowledge of the creation of the new section has not at this writing been made public through the usual channels, but it comes to AVIATION AND AERONAUTICAL ENGINEERING upon such reliable authority that it may be said to be official. We quote as follows from a document dated April 16:

"An agency has been created within the General Staff of the Army for the primary consideration of all inventions, and suggested ideas of inventions, whether patented or not, of a military nature, pertaining to the Army, and which the inventor desires to submit to the Government for inspection, test, development, or with a view to its purchase or use. It is requested that should applications of this nature be received in any of the offices of your department, the same be sent informally and directly to the Inventions Section, General Staff, Army War College, Washington, D. C. Applications made in person by inventors should be referred to the same agency and address."

It is estimated that there are approximately 4,500 inventors who either have been unable to get in touch with the chiefs of these two departments or with the heads of bureaus upon the ground that their time is so taken up with other matters that they have none to spare for such things. Some of these ideas are in various stages of progress. Many of the inventors have been at the capital for months without having been able to secure any action so that it is easily believable that not a few of them had become so discouraged as to wonder whether they would ever get an audience, or would ever learn whether from the Government's standpoint their inventions are good, bad or indifferent. The majority of them came from long distances and by reason of the protracted delays and official inaction have been put to unusual, unexpected and extraordinary expense, which the most of them can ill afford.

Refused a reception and buffeted from pillar to post, they sought a way out of these very unsatisfactory conditions and that agitation resulted this month in a few of them getting together and forming the American Inventors' Association, one of whose principal objectives is to secure the creation of just such a bureau as the Secretary of War has now taken the first steps to establish for his department. Should the Secretary of the Navy take similar action, and it is thought that he probably will, the hitherto existing conditions, of which men with inventions have generally and justly complained should be materially, if not entirely relieved, and it is thought information as to whether inventions are available for Government use will be given with the minimum of delay.

Aerial Mail Starts May 15

The Post Office Department announced that the airplane mail service between Washington, Philadelphia and New York will be started May 15. Military airplanes for the service have been assembled at Mineola, N. Y.

As experiments will be made in dropping mail sacks while the airplanes are in flight, mail for the present will be confined to letters, but later sealed parcels will be accepted.

During the early stages of the service no attempt will be made to dispatch airplanes on days when rain and fog will obstruct the vision of the aviator. On such days the mail will be dispatched by courier on trains and given special delivery service.

The Senate has passed a bill establishing a rate of 24 cents an ounce or a fraction thereof. The bill has gone to the House.

New Aircraft Company Formed

The Carolina Aircraft Co. has been organized at Raleigh, N. C., with an authorized capital of $500,000, of which $20,000 has been paid in. The stockholders are Harry N. Atwood, Howard White, John A. Park, and J. M. Broughton. The first airplane is to be completed in sixty days.

Application for Flying Permits

In paragraphs 1 and 2 of the Presidential proclamation of Feb. 28 last in regard to licenses for civilian fliers are given some of the details which an applicant must set forth in his application. Further information as to these requirements is indicated in the blank form of application furnished by the Joint Army and Navy Board on Aeronautic Cognizance and of which the following is a copy:

APPLICATION FOR LICENSE

License for making flights in civilian aircraft is desired under the following terms and conditions:
(Make separate application for each aircraft.)

License to be issued to:
Name .....
Address .....
Description of aircraft .....
.....
Owner .....
Address .....
To be operated by .....
Address .....

If passengers to be carried, give names and addresses:
Name ..... *Address* .....
Name ..... *Address* .....
Name ..... *Address* .....
Territory in which flights are to be made .....
.....
Purpose for which flights are to be made .....
.....
License to be valid from ..... *to* .....
Date *Date*

Names and addresses of four references to whom applicant is well known:
Name ..... *Address* .....
Name ..... *Address* .....
Name ..... *Address* .....
Name ..... *Address* .....

Signature of applicant:
Name .....
Address .....
Date .....

This application after being properly executed should be sent to
THE JOINT ARMY AND NAVY BOARD ON AERONAUTIC COGNIZANCE,
1607 *H Street, N. W., Washington, D. C.*

While the recent decision of the Board to the effect that no more licenses will be issued to civilians, as has been noted in AVIATION AND AERONAUTICAL ENGINEERING, has been disastrous to the business of private flying schools, manufacturers of planes for private use and others along those lines, modifications of it have been or may be made under certain circumstances.

One of these is that a license may be granted if it is shown that it will be for the public good. An instance of this is the case of Miss Ruth Law, who gave a demonstration with a Curtiss plane of the pusher type during the Liberty Loan parade in Washington, D. C., last week. An application for her to fly was made by and granted to the local Liberty Loan Committee for the reason indicated.

Again, the ruling may be liberally interpreted if the application shows that the purpose of the flight is for testing out a machine designed for war work. Hence, a manufacturer or inventor who wishes to test a plane which may be available for the United States Army or Navy will stand a very good chance of securing a license, even though at the time he has no Government contract.

Stops Patents to Enemies

President Wilson on April 16 stopped the issuance of patents and copyrights to enemies and revoked the authority given Americans to apply for patents in enemy countries.

By executive order the President revoked authority previously vested in the Secretary of the Treasury to issue licenses to enemies to take out of the country papers, pictures or communications relating to letters patent, copyrights or registration of trade marks. At the same time the Federal Trade Commission was prohibited from granting licenses to American citizens to prosecute patent applications in enemy countries.

Major Shepler Resigns from Army

The President has received and accepted the resignation of Major Harry J. Shepler as an officer in the Army. Major Shepler was chairman of the Plane Production Section of the Production Department, Signal Corps, and continued in that position after a Western office was opened and a large part of the personnel was removed to the Union Building, Cleveland, Ohio. The resignation took effect on April 29.

War Service Bureau for Congress

A Congressional Army War Service Bureau is proposed in a bill (H. R. 11894) introduced in the House on May 3 by Representative Sanford of New York. The bill which was sent to the Committee on Military Affairs, is as follows:

"That to promote more efficient cooperation and coordination between Members of the two Houses of Congress and the various branches of the War Department and of the United States Army, there is hereby established a bureau to be known as the Congressional Army War Service Bureau, to which shall be referred for prompt consideration and decision all correspondence received by Members of Congress relating to appointments, commissions, promotions, transfers, assignments, and general disposition of officers and enlisted men of the United States Army. That there shall be in such bureau a Division of Senate Correspondence and a Division of House of Representatives Correspondence in charge of a director, respectively, each of whom shall be detailed by the Secretary of War from the active or retired list of the Army to serve without additional compensation.

"SEC. 2. That the bureau and its divisions shall have such deputies, assistants, clerks, and other employees as may be from time to time provided by Congress. The bureau shall, by and under the direction of the Secretary of War, make use of employees of the War Department and of officers and enlisted men of the Army on the active or retired list to such extent as may be necessary for the proper and expeditious transaction of its business.

"SEC. 3. That the Secretary of War shall submit annually estimates of the appropriations necessary for the work of the bureau.

"SEC. 4. That for the purpose of carrying out the provisions of this Act, there is hereby appropriated, out of any moneys in the Treasury not otherwise appropriated, the sum of $100,000, or so much thereof as may be necessary, for the payment of all expenses incident to the work authorized under this Act, including salaries of all employees other than those detailed from the War Department and from the Army, employed in the District of Columbia and elsewhere, as the Secretary of War may deem necessary, rent and equipment of offices, typewriters and exchange of same, and all other necessary expenses: *Provided*, That the use of unassigned or unoccupied portions of the Senate and House Office Buildings, respectively, is thereby authorized to the extent that may be necessary for the temporary accommodation of the bureau.

"SEC. 5. That all officers and employees of the bureau not detailed from the War Department or from the Army shall be appointed from lists of eligibles to be supplied by the Civil Service Commission and in accordance with the civil-service law; salaries shall be the same as are paid for similar services in other departments of the Government.

"SEC. 6. That it shall be the duty of the directors of the Congressional Army War Service Bureau, under such rules and regulations as the Secretary of War shall prescribe, to receive and promptly dispatch replies to letters, telegrams, and other forms of correspondence addressed to Senators and Representatives in Congress, and to Delegates and Resident Commissioners, relating to the personnel of the Army, and to furnish information concerning the same in accordance with the Army regulations, military orders, and general orders of the Secretary of War. But no recommendation of any person who shall apply for appointment, commission, promotion, transfer, or assignment, in the military service of the United States, which may be given by any Senator, Member of the House of Representatives, Delegate, or Resident Commissioner, except as to the character and residence of the applicant, shall be received or considered by any official or employee of the War Department or of the bureau created by this Act or by any officer of the United States Army."

Alexandria Aircraft Corp.

The Briggs Aeroplane Co., of Alexandria, Va., will be known after May 15 as the Alexandria Aircraft Corporation. Blaine Elkins continues as president, while A. W. Briggs, general manager, retires to engage in other business.

Aircraft Workers Buy Bonds

The employes of the Wright-Martin Aircraft Corp., New Brunswick, N. J., subscribed over $500,000 for the Third Liberty Loan.

Magneto Plants Seized by U. S.

The Bosch Magneto Company's plants at Plainfield, N. J., and Springfield, Mass., were recently taken over by the Alien Property Custodian. The company manufactures magnetos for airplanes, automobiles, trucks and other Army and Navy equipment. The estimated value of the property is about $5,000,000, with a capital stock of $25,000.

Custodian Palmer's announcement on assuming control of the plant said:

"Prior to the entrance of the United States into the war this company had refused to take orders from the Allies, and after the United States went in it was loath to render any service to the Government in its activities against the Fatherland. The directors to be appointed by the Alien Property Custodian will immediately take charge of the works. They will be operated in full by the United States and the entire product be placed at the disposal of the munitions committees. As this is one of the best equipped plants in the country, its output will be of inestimable value to both the Army and Navy.

"After the examination conducted by Francis P. Garvan, director of the Bureau of Investigation, and examination which is tracing the ownership of many properties in various parts of the country, all the capital stock of the Bosch Magneto Company has been proven to be owned by Robert Bosch and other residents of Germany. When first reported by Carl Schurz, of New York City, as president, in December, 1917, he claimed that all but a small proportion was owned by residents of this country.

"At the time of the declaration of war Otto Heins, who was then president, and many of the German heads of departments walked out of the mill with the purpose that this concern should not be used in making war upon Germany. The present directors are Carl Schurz and Gustav Jahn. These directors will be replaced by directors designated by the Alien Property Custodian."

Naval Fliers to Make Frequent Flights

On March 14 the Secretary signed a General Order, amending General Order No. 205, dated April 12, 1916, and requiring flying under flight orders. This order, which was not issued until last Saturday, reads as follows:

"1. All Naval personnel detailed for duty involving actual flying in aircraft shall, while so detailed, make flights in such frequency that at no time shall more than one calendar month intervene between flights.

"2. In any case where more than one calendar month shall have intervened without a flight being made, flight orders will be held as in abeyance after the expiration of the first successive calendar month and will continue to be held in abeyance until the first of the succeeding month in which a flight is made. The receipt of increase in pay and allowances for duty involving flying will be prohibited during the period in which the flight orders are in abeyance.

"3. In the case of individuals failing to perform a flight because of physical disability incident to flying, flight orders during the period of such disability will be considered as fully in effect."

Anti-Aircraft Gun Trailers

In a description of motor vehicles, etc., made by the Ordnance Bureau, War Department, are given the following data of two anti-aircraft gun trailers for the U. S. Army:

The one and a half-ton anti-aircraft trailer is supplied to transport the 75 mm. improvised anti-aircraft gun. Two trailers are used to transport each piece, one carrying the gun and cradle, and the other the gun platform.

The three-ton anti-aircraft gun trailer, weighing about 4200 lb., is designed to have permanently mounted upon it a 75 mm. anti-aircraft gun. This trailer also carries a box containing ammunition.

General Aeroplane Co. Discontinues Business

The General Aeroplane Co., formerly manufacturers of aircraft at Detroit, Mich., has discontinued operations.

Standard Screw Co. Changes Name

The Standard Screw Company of Pennsylvania, Corry, Pa., have recently changed their name to the Standard Turnbuckle Company.

"A Great Net of Mercy Drawn Through an Ocean of Unspeakable Pain"

What Your Red Cross Dollars Do

An accounting of Expenditures of the First Red Cross War Fund

Every one of the twenty million and more Red Cross members is entitled to this statement. Your local Red Cross Chapter can give you further details.

First War Fund Appropriations up to March 1st, 1918

Foreign Relief:	
Relief in France	$30,936,103.04
Relief in Belgium	2,086,131.00
Relief in Russia	1,243,845.07
Relief in Roumania	2,676,368.76
Relief in Italy	3,588,826.00
Relief in Serbia	875,180.76
Relief in Great Britain	1,885,750.75
Relief in other Foreign Countries	3,576,300.00
Relief for Prisoners, etc	343,304.00
Equipment and expenses in U. S. of Personnel for Europe	113,800.00
Total Foreign Relief	$47,325,609.38
Restricted as to use by Donor	2,520,409.57

United States Relief:	
U. S. Army Base Hospitals	$ 54,000.00
U. S. Navy Base Hospitals	32,000.00
U. S. Medical and Hospital Work	531,000.00
U. S. Sanitary Service	403,000.00
U. S. Camp Service	6,451,150.86
U. S. Miscellaneous	1,118,748.41
Total U. S. Relief	$8,589,899.27
Working capital for purchase of supplies for resale to Chapters or for shipment abroad	15,000,000.00
Working cash advances for France and United States	4,286,000.00
Total of War Fund Appropriations	$77,721,918.22

At the close of the first year of the War the Red Cross goes to the public for the raising of the Second War Fund with a record of appropriations which warrants continued contribution to this great relief work. As an influential citizen of your community, join with your local Red Cross Chapter to make this campaign successful. Your Red Cross is the Army behind the Army. Give till your heart says stop.

Second Red Cross War Fund Week May 20-27

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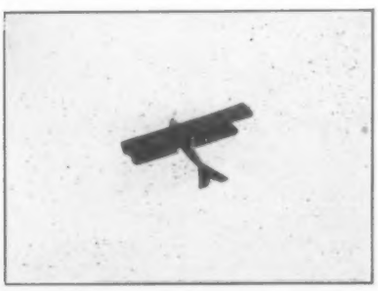

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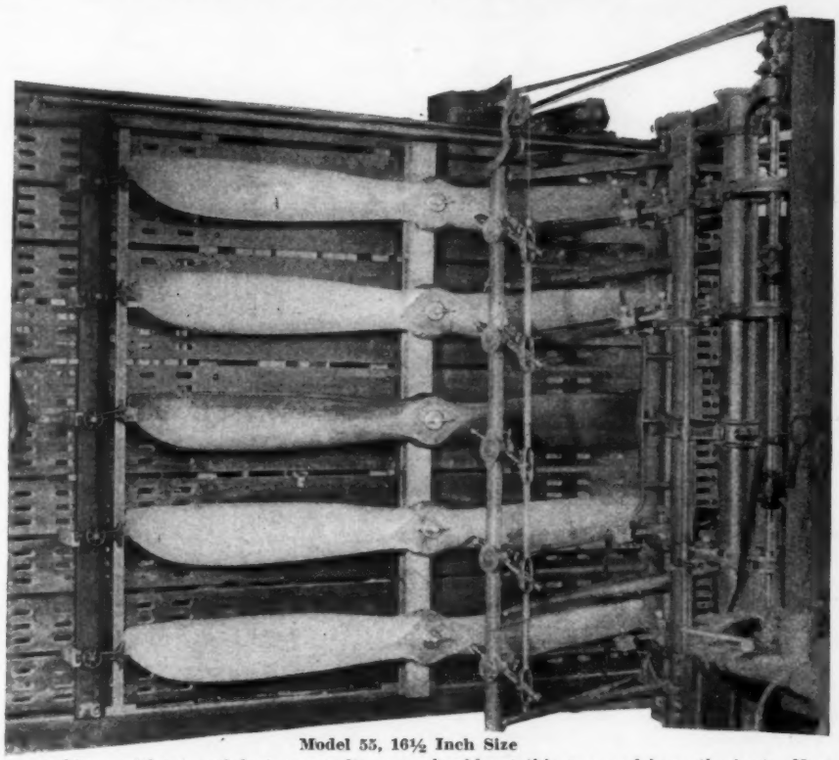

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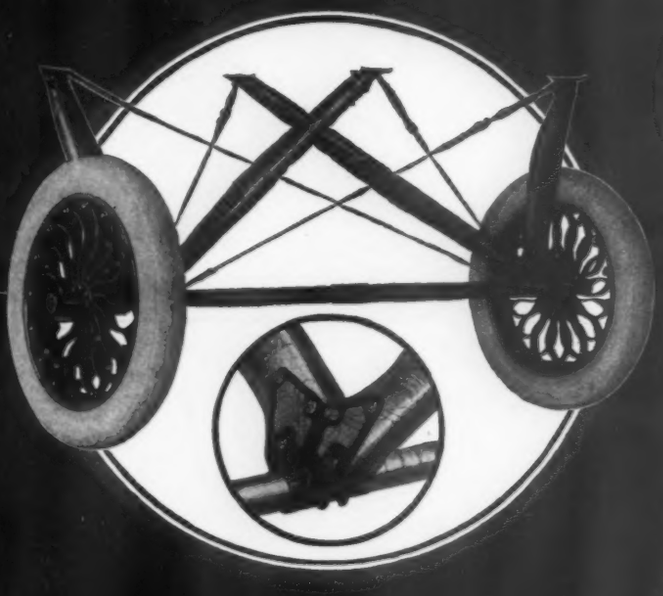

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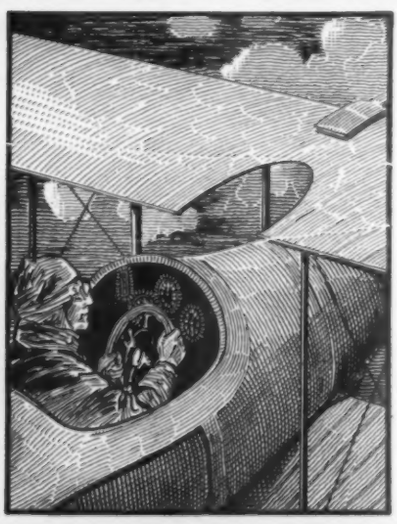

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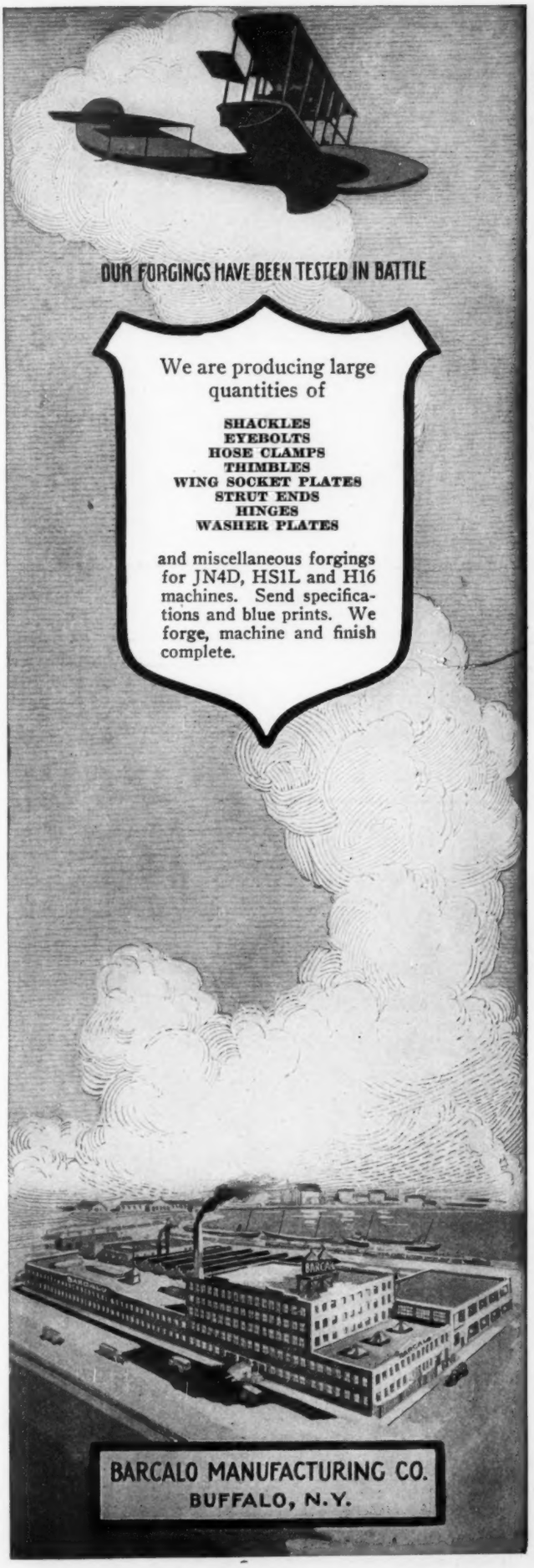

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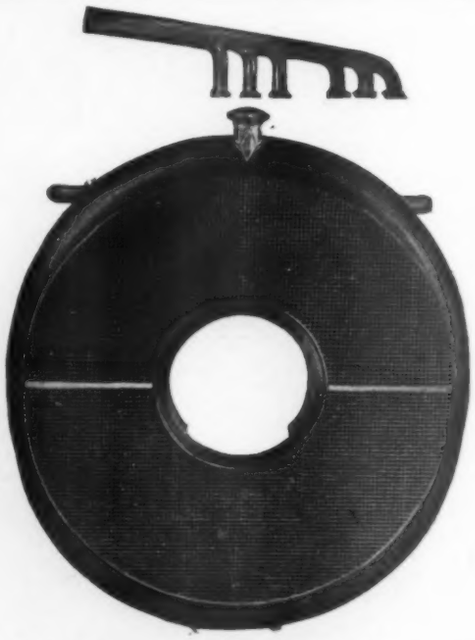

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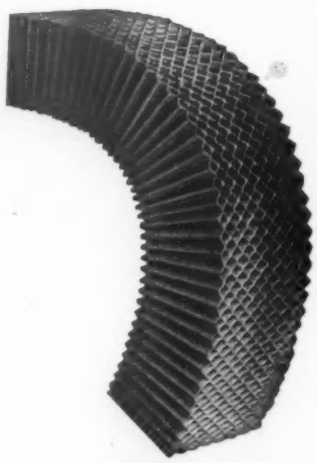

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(Continued from page 553)

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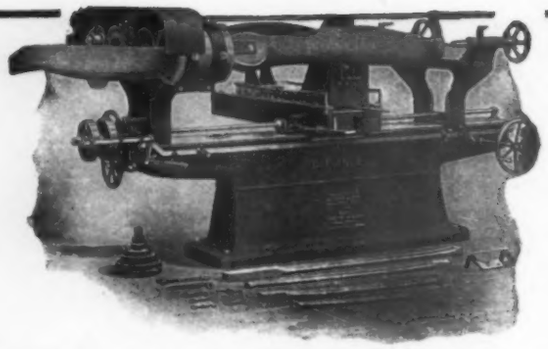

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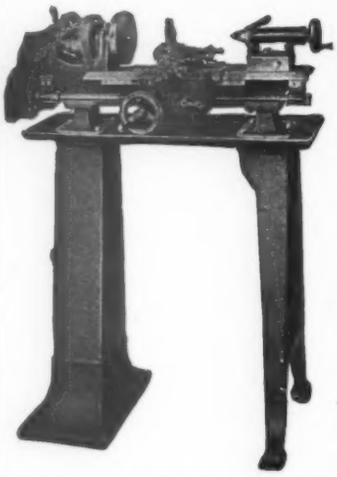

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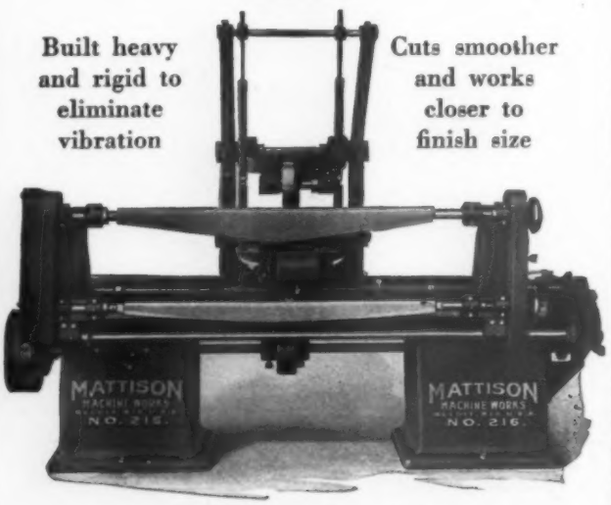

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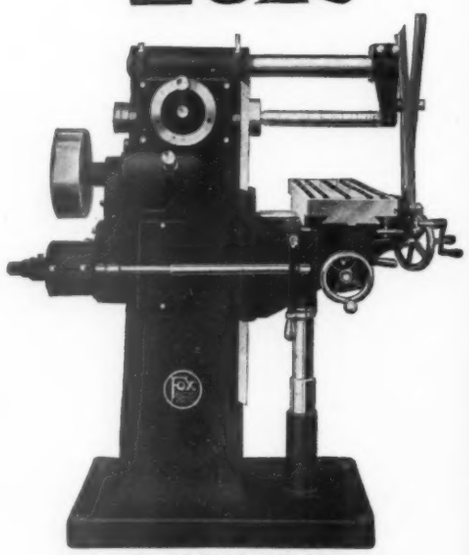

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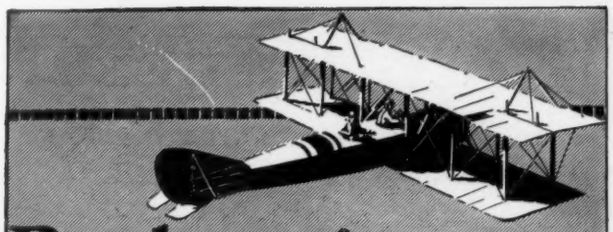

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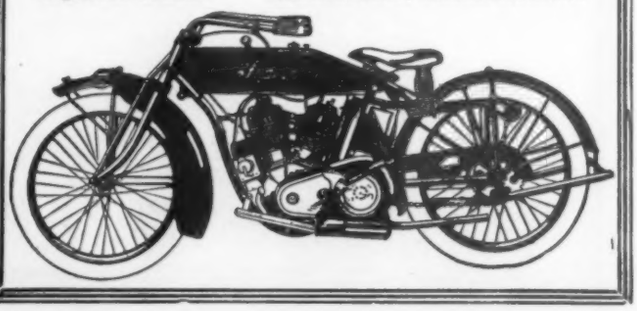

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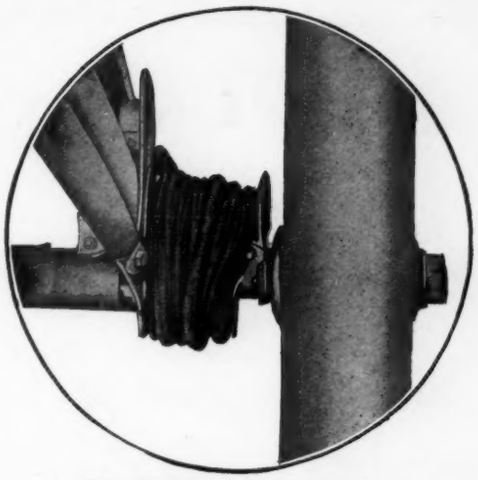

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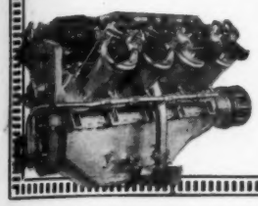

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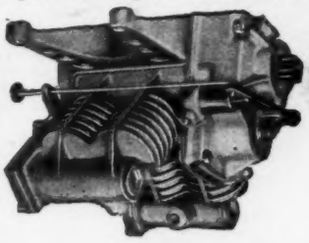

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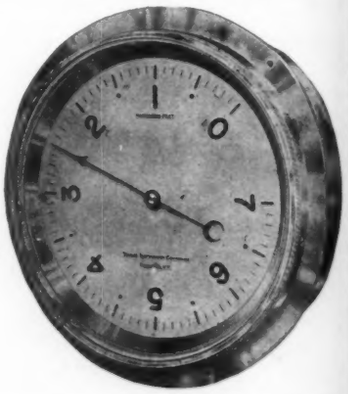

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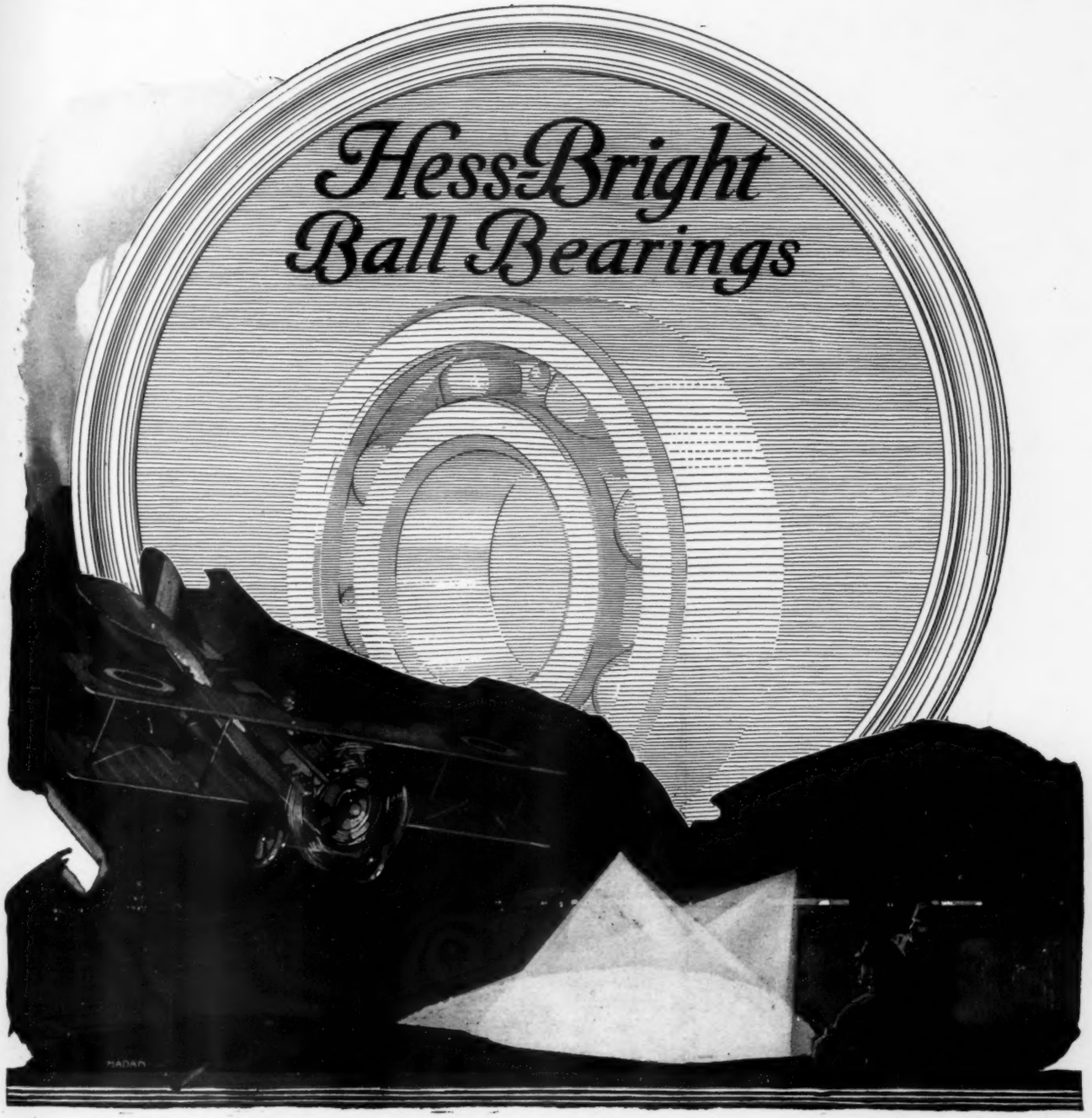

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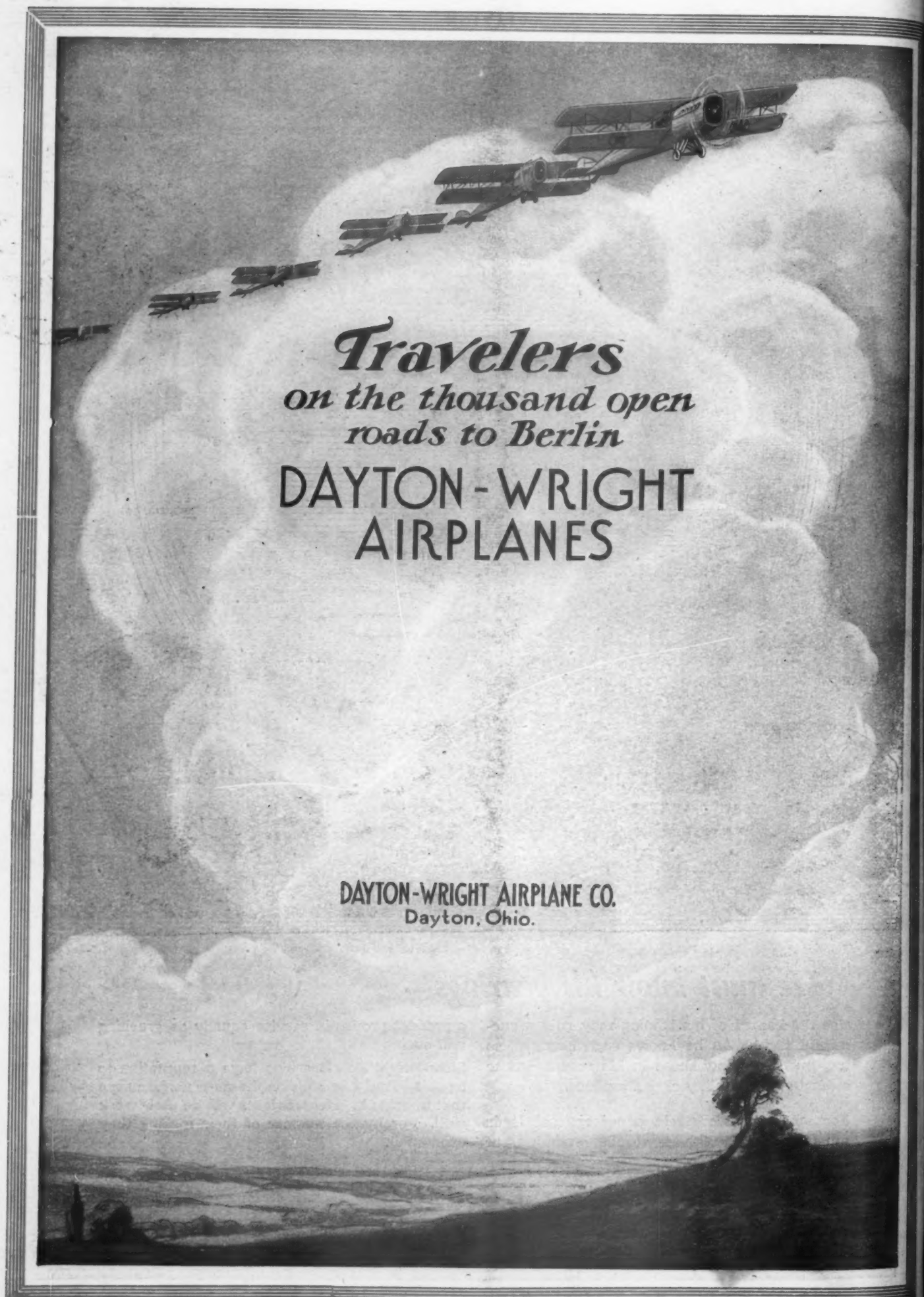
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